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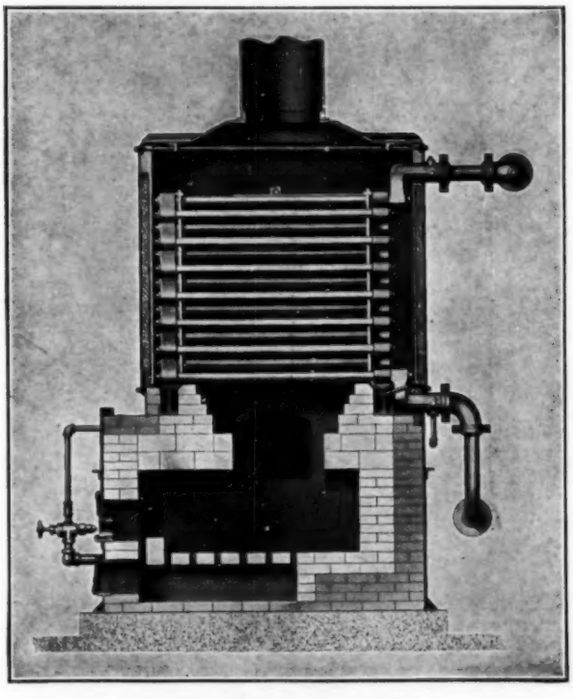

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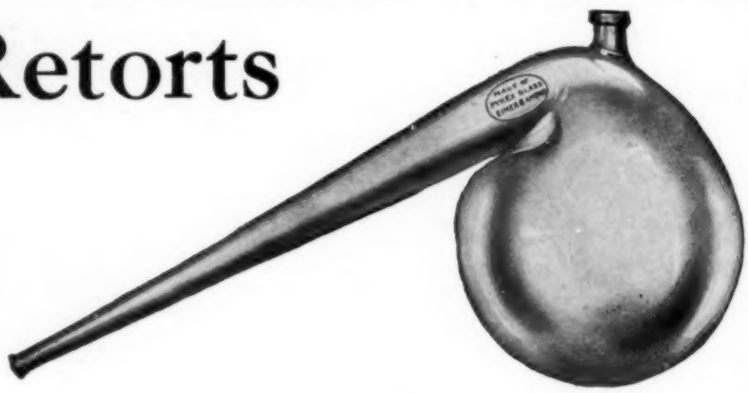

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The Railroad Wage Decision

THE wage decision announced May 29 by the Railroad Labor Board, signed by the three railroad members and the three public members of the board, states that the new wages will be higher than in other industries for similar work, a margin having been allowed to cover the hazards of employment and other considerations. The dissenting opinion, of the three labor representatives on the board, says that the wages decreed are insufficient to sustain life on the basis of American standards.

Here is a big issue and at the same time a very simple one. It cannot be claimed that the wage rates prescribed are relatively low, for the board had ample basis of fact to warrant the statement that railroad wages will be higher than other wages. The contention of the minority, then, is in essence that all wages in the United States are too low to sustain life on the basis of "American standards."

Now the use for wages is to spend them for commodities and services. The commodities and services must be available or they cannot be bought. Imagine a small island inhabited by a single native possessed of a certain amount of food. Two men are shipwrecked on the island, each with $1,000 in his pocket, and the native is quite willing to sell all the food he has. Each of the shipwrecked men, other things being equal, will get half. If before they started to bargain you had given each man $1,000 more money they would not have got any more food. There would simply be $4,000 passed over instead of $2,000. The food would not be Americanized by that means.

Estimates of the national income of the United States made respectively by counting up individual incomes and by counting up the value of the production substantially agree. The income buys what is offered for sale. If we want more we must produce more. We cannot increase the quantity of material and the amount of service by bidding more dollars.

To carry on industry at all in these days the workers must have tools and direction. The railroad workers could accomplish nothing without cars, locomotives and track, or without managers to direct their work. These things, tools and management, have to be paid for. Approximately speaking, between 20 and 30 per cent of the total national income goes for these purposes, workers for wages and salaries getting the other 70 or 80 per cent. And there is strong reason for holding that the workers are better off when the share for tools and management is 30 per cent than when it is 20 per cent.

There is, then, only one way to bring about a higher standard of living generally, and that is to increase production, by men working harder and more efficiently and with better tools.

Artificial Industrial Conditions In Europe and Germany

HISTORY portrays LOUIS XV as a conspicuous example of the indifference of a monarch to the welfare of the masses and the consequences of his own extravagance. When his advisers remonstrated with him, he is reported to have said, "After me the deluge." The expression typifies the attitude of the then ruling class.

Something of the same spirit is to be observed today among industrial leaders in Europe. In Belgium and France a few powerful leaders and their entourage feed the people with the doctrine that everything will be all right when Germany pays the reparations, but in the meantime the people are burdened with taxes and privations. In Italy speculators in depreciated money exploit the means of production to their own profit. In Switzerland another group buys at depreciated foreign value and sells at home at Swiss currency value with resulting profit to themselves and damage to Swiss production. In Germany industrial and economic conditions are critical to the breaking point. Russia has already disintegrated under the baneful influence of a small but dominant group of leaders. In fact, throughout Europe one can observe artificial industrial and economic conditions created by small groups of leaders whose opinion is dominant for the moment, but whose thinking is unsound. Not only are these things largely responsible for the industrial situation in Europe, but the repercussion of bad business resulting from unsound economics is felt in the United States and affects our own business revival.

In Germany particularly we may observe a curious combination of conditions. Production is at full capacity. There is no unemployment, and yet wages are abnormally low. The bulk of production is exported at prices comparatively lower than for home consumption; but the revenue, instead of finding its way into Germany to ameliorate local conditions, purchase raw materials and repair the wrongs of the war, is invested outside the country as personal insurance of the industrialists against the inevitable ruin that must overtake the unsound business policy at home. It seems inconceivable that industrial leaders can thus selfishly hasten the bankruptcy of their country, but such apparently is the case. After them the deluge!

In order to justify this treatment of the laborer, whereby he gets but a small fraction of the value of his labor, he is fed with the doctrine that exportation is necessary in order to meet the reparations, and that the price must be low in order to meet competition. At the same time the doctrine of hatred for the Allies is being instilled into the worker so that he will the more readily accept the unfair treatment to which he is subjected. The picture is not a happy one, revealing as it does the domination of the country by a compar-

atively small handfuls of industrialists who exploit the people to their own advantage. This domination, we learn, extends also to the press and even affects scientific research, but that is another story. The sad fact is the present domination of one class over a mass of 70,000,000 people.

Another curious phase of the situation seems to be a fear, certainly an unwillingness, on the part of the intellectuals of the country to expose this uneconomic and unfair industrial policy and bring to bear through some medium or other the pressure of opinion that would immediately modify existing conditions. Engineers, scientists, technologists, economists and other trained thinkers in Germany recognize the folly of the present artificial industrial situation, and yet they are evidently without courage to express their opinion or exert their influence. In this country they would have the benefit and co-operation of an independent technical and business press through which to voice their protests.

This leads us to say to the technical press of Germany that it has an unprecedented opportunity for service to its country and the technical industries which have flourished there so highly. If the technical press itself is not also under the domination of German industrial leaders, let it adopt a vigorous editorial policy that will expose the futility of the present industrial system and the disaster to which it must inevitably lead. Let the German intellectuals, whose own independence is threatened by industrial domination, and whose welfare is directly affected by the present situation, express their honest opinions regarding the exportation of German production and the exploitation of the workers by a few leaders who are profiting at the expense of their own national prosperity. If a beginning of this kind could be made, we believe it would grow in volume and influence until it would become a strong factor in rectifying the present uneconomic condition.

A Research and Educational Plan For the Packing Industry

FRANK analysis of the present trend of development in the packing industry, keen appreciation of work being done in other industries to advance the science of efficient and economical production and a sincere desire to have the largest industry in the country keep step with such progressive movements characterize the development plan for the Institute of American Meat Packers prepared by the president, THOMAS E. WILSON. By recent action of the executive committee, the plan has been transmitted to the entire membership for consideration at the next convention.

Since its establishment in 1919 by reorganization of the American Meat Packers' Association, much of the Institute's work has been directed toward the establishment of more cordial relations with the livestock producers on one hand and the retailers and the public on the other. These efforts, as well as others within the industry itself, have been attended with such a measure of success that Mr. WILSON sensed the opportunity for laying out a definite plan of enlarged activity and broader service, to guide and stimulate future growth.

Critical analysis of the methods by which the industry is progressing at present discloses several ways in which the Institute could function for the benefit of the whole industry. Attention was directed particularly to such points in the present system as: Unnecessary duplication of research and development work; the lack of an adequate system for perpetuating and handing down to the next generation in readily available form the results of past experience; lack of organized instruction of employees; no opportunity for executives in one branch of the business to broaden their perspective; no educational feeder of men whose training fits them especially for this industry.

With these points in mind, Mr. WILSON has outlined a plan for the Institute, details of which appear in our news pages of this issue. It contemplates an ambitious program and one which will require detailed study to determine the best method for carrying out each recommendation. For this purpose, Mr. WILSON proposed an Institute plan commission, which has been appointed by the executive committee with instructions to begin functioning at once. In this way no time will have been lost should the proposals of the commission be approved by the convention. This action indicates the presence of a genuine spirit of progressive co-operation in the packing industry, and it is to be hoped that the plan will materialize. It will be a great step forward.

Big Business And the Technical Man

ANOTHER billion dollar merger! Independent steel companies to form a trust which will rival the U. S. Steel Corporation!

So say the newspapers. Adjectives such as immense, colossal, gigantic come to mind. If you have ridden by the properties along the shore of Lake Michigan—a part only of the prodigious scheme—the physical magnitude of the project will begin to dawn on you.

What does such a project do to the technical men in the organization concerned? What of their work, their prospects, their future? A very pertinent comment of STEPHEN LEACOCK may find happy application here. Said he in substance: "A man who has a million dollars may be a good fellow, enjoy golf, play a good game of bridge and tell a good story. A man with five million dollars may still be able to speak graciously to his employees and colleagues, but a man with twenty million is just twenty million." There is something very similar about corporations. A small corporation may be imbued with the kindly spirit of a splendid man. A larger corporation may feel the personality of someone, but to a lesser extent. The larger the corporation becomes the more like a ruthless, inexorable machine it seems. The individual becomes a cog. Whole groups of individuals are lost to view. The great machine grinds on.

Technical men do not suffer as does the untrained man, but it reduces business relationships to its lowest terms. Big business cannot easily ask for loyalty when it reserves the right to eliminate a man or groups of men for mere expediency and not because of individual lack of worth or lack of effort. The problem is large and is ours as well as that of boards of directors. It must be solved by compromise. Loyalty and enthusiasm we give for fair treatment and security. Can big business pay the price? Can billions become human?

The answer is not going to be found in welfare committees, but in a genuine effort in business to regard the individual as a person with ideals and aspirations, with needs and desires and not as a cog—a unit quantity of energy purchased like so much lemon juice while the rind is cast out with the refuse.

Is the Steel Corporation On the Decline?

A MONTH or more ago the United States Steel Corporation held its annual meeting and its twentieth yearly report was presented to stockholders. Judge GARY made, as usual, a felicitous address and any stockholder present had the opportunity to say what he pleased or to ask questions. The meeting proceeded in amity and the chairman of the board, the finance committee, the executives and the directors were justly thanked by the stockholders for their able services and competent administration of the corporation's affairs.

Judge GARY said among other things: "The corporation has made steady, intelligent progress from the time it started. We have fortified our positions, we have become stronger, we have added to our capacity and our wealth. . . . We expect to meet competition, sharp competition. We have no feeling of hostility toward competitors or anyone else. We are going to do our duty as we see it. . . . We are subject to criticism . . . and sometimes it will be unfair. That has no influence upon us except, when we hear or read a criticism which we think is deserved, we try to improve our methods accordingly."

We agree with the stockholders present in believing that the corporation is to be congratulated on its excellent leadership and its frank reports of its conditions—with one reservation. Its leadership is immensely able so far as it leads and its reports are full so far as its property, sales and cash accounts are concerned. The criticism that we make is presented in all good will and from the standpoint of a stockholder of long standing.

Here is the greatest corporation in the world. Its leading occupation is within the field of metallurgy. It produces and sells mainly iron and steel, although its vast dominion includes the production and sale of cement and the operation of gas wells, railways, steamships and a great variety of subsidiary activities. Now in all the report and in the remarks of the chairman and in the comments of the stockholders themselves it would seem as though not only the theory of steel making but the technology itself were but minor features, whereas the number and size of the blast furnaces, the list of mines, quarries, railroads, steamships and above all things of sales, were the features of leading interest. We fail to find any reference to the quality of its products. The statistics have to do principally with tonnage. Of course, it may be said that big tonnage proves quality to be satisfactory, but the blind spot may be found in that very statement! How do we know that the quality of today will be satisfactory tomorrow? Or that the costs of today may not be lowered by research by next year, and with no reference to wages or coal or transportation costs?

In other words, the very heart of the business passes without comment. Steel is the subject of constant research, and improvements in product and in processes are constantly reported by the corporation's competitors. We are familiar with the fact that many of the Steel Corporation's subsidiaries maintain well-equipped research staffs, but whatever they find out is apparently held for internal consumption only, or is directed solely to the solution of operating difficulties appearing under their own special conditions. If any fundamental researches on iron, steel or its alloys is being done, nothing is being said about it. As a matter of fact, we men of today know that to talk of secret research and practice of metallurgy is a delusion.

We do not find on the board of directors or among the leading administrators of the Steel Corporation, as published, a single man of scientific training or of whom it is reasonable to expect that he has the scientific vision. It appears to be operated by the Old American Method under which finance and legal acumen control, while Science punches the time clock and is hired and fired according to the pleasure of the finance committee. We may be wrong in this view, but the report gives the impression. The New American Method is that practiced by the General Electric Company, the Westinghouse Company, the American Telephone & Telegraph Company and a number of other organizations that keep constantly in the forevan of scientific knowledge and understanding because they practice research, welcome theory, resolve it into practice—and then are not ashamed to tell the tale.

With all good will we wish the Steel Corporation would indicate an interest in the scientific side of its great business and change over to the New American Method of administration. It would be a grand thing for this country if it did. We believe it would be following a course of self-preservation as well, for undoubtedly the metallurgical progress of tomorrow is not to come through bigger business or bigger blast furnaces and rolling mills, but through the precise application of science for the production of quality metal.

Judging Coal Prices

HOOVER, with customary courage and vigor, promises to fix on his own personal responsibility a set of fair prices for coal. So long as the present labor disturbance in that industry creates an emergency, he will ask those producers who are able to operate to accept as a fair price no more than the charges which he will name after careful consideration of all factors in the situation. This is a public service of first magnitude. The Secretary quite properly says in this case that a man who is not willing to accept on behalf of the public the burden of large responsibility in time of emergency is not competent for public office. Judged by this measure, and for any other so far as we can observe, no one can gainsay Mr. HOOVER'S full competency as Secretary of Commerce.

But there is another side to the question and another responsibility in the matter which rests upon coal purchasers. Those in the chemical industry who find themselves with unfortunately low coal stock should do their best to avoid competitive bidding in limited markets. It may be that the need for coal will quite justify on a dollar-and-cent basis the payment of exorbitant prices temporarily. But wherever possible the purchaser should avoid any such payments as will tend to undermine the work of the Secretary in fixing fair base prices for bituminous coal.

Whenever it may become necessary to pay a bonus or excess above a "fair price," it is to be hoped that the purchaser will do it under protest. And this protest should not be the only result. Mental note should be made of those producers or dealers who use the emergency situation as an opportunity for large profit. If industry once makes coal profiteering unprofitable, it will promptly disappear. Now is a golden opportunity to accomplish this. A moral standard of action has been set up. The coal user will have full basis for judgment. Let him exercise it.

Readers' Views and Comments

Shipping in Bulk

To the Editor of Chemical & Metallurgical Engineering

SIR:—Your editorial on containers for coconut oil in the April 12 issue is of interest, but I suggest that the objection against the use of oil tankers for this purpose is not an insuperable one. After an experience in coconut plantations and on ships carrying copra in the tropics, I can bear witness to the deteriorated condition in which the dried coconut reaches the oil-expressing plant after a long journey. This we found was due largely to the propagation of what are known as copra bugs—small black beetles; these multiply with amazing rapidity in the humid atmosphere and help to flavor the sickening stench that emanates from the hold of a ship carrying copra in the tropics. It is one of the mysteries of chemistry that an edible and odorless product can be produced from such material, but experience has proved that it can be done with remarkable success.

My point is that if odorless preparations can be made from copra in such a condition, surely it is possible to cleanse tankers so that the degree of contamination of the vegetal oil with petroleum on the return trip would be negligible. The holds of such tankers are, I believe, fitted with steam coils, by which it should be possible to facilitate cleansing. The cost of the operation, in proportion to the enormous saving in freightage and transference, would be insignificant. Much deterioration would be avoided.

One of the heaviest costs in shipping nitrate from Chile is for the jute sacks, which come from India. The nitrate is sacked at the oficina and taken on flat cars to the port. Here it may lie in a warehouse until the individual sacks need be pried apart. Damage also occurs when loading into the lighter, during transference from the lighter to the slings and from the slings to the ship's hold. In many cases the number of intact sacks that have survived the jars and jolts of travel and have escaped being torn apart by the ugly hooks used by the Chilean stevedores is only enough to form four walls to inclose a pile of torn jute and loose nitrate in the center of the hold. Much resacking is done on the lighter and more at the port of arrival, all of which tends to increase greatly the ultimate market price.

It has been maintained that Chilean nitrate cannot be shipped in bulk, on account of its cementing properties. However, it would appear that, if clean and dry, there is no danger of such action. From my experience with this product in Chile I can see no reason why these two conditions could not be obtained at small expense.

To date, in spite of the magnitude of the natural nitrate industry, little attention has been paid to the question of the special freighting of the product. The present methods are not only expensive but unnecessarily wasteful. As soon as Chilean nitrate meets with serious competition with a synthetic product manufactured in the United States it is probable that economies in transportation methods will be adopted that will reduce appreciably the cost of fertilizer to the consumer.

San Francisco, Cal. A. W. ALLEN.

Rapid Determination of Tungsten

To the Editor of Chemical & Metallurgical Engineering

SIR:—The following method for the determination of tungsten should be of interest to chemists who must make preliminary tests on electric furnace heats. For such work time is valuable. With good facilities a tungsten determination by this method can be completed in 35 minutes, and the results are absolutely dependable. It is not applicable for steels containing large amounts of chromium or for high-speed steels, but the writer has been using it very successfully for more than a year on steels containing up to 1.50 per cent carbon and up to 1.50 per cent tungsten. Proceed as follows:

Dissolve 5 grains of drillings in an 8-in. evaporating dish with 90 c.c. of 1:2 nitric acid. After violent action is over, place over a high flame of an Argand burner and boil until action ceases. Add 20 c.c. of potassium permanganate solution (30 grams per liter) and boil for several minutes; add sodium nitrite solution (25 grams per liter) until the manganese dioxide has all been reduced.

At this stage the solution in the dish should be a clear amber color, as all the tungsten will be in solution. If any scale has been weighed up with the steel, it can be seen readily and should be removed, as it will not dissolve later. However, it is better to make sure that the sample contains no oxide, as the result will be vitiated accordingly.

Add a small spoonful of paper pulp and 30 c.c. concentrated hydrochloric acid and continue boiling; then add 100 c.c. of boiling water, next 15 c.c. of cinchonine solution (75 grams per liter of 1:1 HCl) and continue the boiling for 5 minutes. Filter through a 15-cm. Swedish filter No. 0, using suction. Wash thoroughly with a wash made as follows: 900 c.c. water, 35 c.c. concentrated HCl and 15 c.c. cinchonine solution. Use this wash hot. Burn in a weighed platinum crucible and weigh.

The difference in weight calculated in the usual way gives the tungsten, which will be free from silica, and if the operator has been careful it will also be free enough from iron for general technical purposes.

Bridgeville, Pa. FRANK G. ROHM.

The Ignorant Forge Shackles for Progress

To the Editor of Chemical & Metallurgical Engineering

SIR:—Right you are, Brother Parmelee! Whether or not you were directly responsible for the editorial headed "The Ignorant Forge Shackles for Progress," I wish to commend your courage and judgment in printing it.

One of the editors of a Maine newspaper (not our own local) assured me the other day that we need expect no trouble from Bryanism, for the very simple and obvious reason that no thinking man would listen to Bryan; conversely, he (Bryan) and others like him need expect to number among their disciples *only* the unthinking. What a comforting thought for those of us who like to feel that we do, occasionally, think!

At a conference of ministers which I had the pleas-

ure of attending in a lay capacity not long ago, one of the members insistently called attention to this menace to intellectual freedom. The assembly, representing what is usually considered the most liberal and progressive of all the denominations, listened more or less patiently to what he had to say—and turned to other matters of greater importance.

Are we asleep? Do we not realize that the docile sheep are in vast majority; and that once they have been stampeded the independent goats (pardon the implication) may butt and kick and dance and bleat to the limit, and will succeed in nothing but in making a spectacle of themselves?

Do we imagine that the days of Quaker persecution and of the hanging and burning of witches are so far away that they can never come back? Those things happened yesterday, and may happen again tomorrow. My wife's maternal ancestor, Cassandra Southwick, not so very many generations back was cruelly whipped at the cart-tail for refusing to give up her spiritual and intellectual independence at the behest of the fanatics of Salem. It is not pleasant to think that our great-grandchildren may, some time, suffer a like humiliation. Is the picture overdrawn? It is not.

It is for the few—among whom we like to count ourselves—who know how to place a true value upon freedom of thought, to throw off their coats, roll up their shirt-sleeves, and pitch in. *Otium cum dignitate* has been the motto of the scientific thinker too long: let's keep what "dignitate" we may, but throw "otium" into the discard.

FREEMAN F. BURR,
Acting State Geologist.

Augusta, Me.

Italian Chemical Industries

FROM OUR SPECIAL CORRESPONDENT

GENOA, ITALY, May 2, 1922.

IT IS altogether appropriate that the Italian chemical industries behaved somewhat like a turtle during April. The Italian lira was undergoing very severe oscillations in value and consequently the foreign values of the lira fell. Many reasons lie behind this variation, the overcrowding of ports with retarded deliveries of coal and raw material, the general excitement created by the International Conference at Genoa and many others.

TRADE ASSOCIATION IN THE ALCOHOL INDUSTRY

A large and comprehensive trade association was organized recently at Brescia for protecting the interests of the distillers of alcohol from grape residues. It is expected that this organization will be able to effect considerable improvement in conditions.

SULPHUR MARKET SLOW

It is quite natural that the sulphur industry should continue at a low ebb owing to the lower quotations of the lira in America and to special local conditions in addition. Several new firms, however, were incorporated for the exploitation of new or neglected sulphur mines in Sicily, one of them with a capital of 100,000 lire. The production in 1921 of brimstone reached 284,000 tons, that of ground sulphur 28,000 tons and of iron barytes 448,000 tons. This represents about one-half of the pre-war figure. A corporation created for assisting the sales of sulphur was able only to dispose of 105,000 tons during 1921, of which 42 per cent was destined to continental Italy. In order to assist the industry, the government has reduced taxes and arbitrated the wages of workers in sulphur fields and also taken action with regard to disputes between agriculturists and other land owners and the sulphur mines. Railway tariff is also under revision.

SULPHATE OF SODA EXTRACTION

Mines near Bompensiere in Sicily are ready to be worked for sulphate of soda. Mineral deposits in these mines consist principally of glauberite (sulphate of lime intermixed with sulphate of soda). Warm water is used to extract the sulphate of soda in the mine shaft and the concentrated solutions are then pumped to the surface and crystallized out. A similar principle of extraction is used in Austria. It is thus possible to use material much poorer in sulphate of soda contents than would ordinarily pay to extract.

ACIDS AND FERTILIZERS

During the past year a great deal of profit was made by Italian fertilizer work and several new firms have been created in spite of the effort of the Montecatini Works, which is trying to absorb all of the Italian production. A new fertilizer has come into prominence, consisting largely of mineral sulphate with concentrated sulphuric acid and a small quantity of cyanamide. Sales of fertilizers, very light early in the spring, have increased now and have already passed the sales of the corresponding period last year. A new process has been developed by the Prodotti & Concimi Chemical Co. for using the waste vapors from the Gill stoves in making sulphuric acid. These until now have been entirely lost and a considerable reduction in the market price of sulphuric acid is to be hoped for as a result of this interesting experimental work.

MINERAL PRODUCTION

Below are listed a number of products used in chemical industries, and the figures which follow them refer to the tons produced in 1921:

Magnesium sulphate, 350; barytes, 13,500; china clay, 13,500; carbonate of lime powder, 6,500; asbestos, 420; graphite, 7,750; boric acid, 2,500; alunite, 1,170; mercury, 1,070; rock salt, 45,400; gold minerals, 80; silver minerals, 9,000; copper minerals, 22,700; lead minerals, 26,500; iron minerals, 274,000; manganese minerals, 4,700; zinc minerals, 69,000.

Recent cable dispatches indicate that business conditions in Italy are improving. The number of business failures is considerably less in April than it was in March, and unemployment is also encouragingly decreased. Government expenditures during the last half of 1921, as recently announced, represent a cut of 25 per cent over the same period in 1920. All of these things indicate a healthy and recuperating condition.

Artificial Silk Manufacture in Italy

There are five mills in Italy, all in the northern section, manufacturing artificial silk. Their total production is about 8,000 kg. (17,637 lb.). One of these factories, situated in Venetia, employs about 1,000 laborers, of whom 800 are women, and produces about 2,000 kg. of artificial silk. This concern is erecting two new mills, one at Naples, the other at Rome, which are expected to be completed in 1923. Most of the artificial silk manufactured in Italy is uncolored. The Italian industry now exports considerable amounts of artificial silk in addition to supplying the domestic demand. In 1921 the total exports amounted to 588,834 kg., of which 173,876 was sent to the United States.

Regional Meeting of Steel Treaters in Pittsburgh

Standardization of Tool Steel Opposed by Dr. Mathews—Fiber in Steel, as Revealed by Macro-Etching, Essential for Tough Metal—A Machine for Measuring Abrasive Resistance Described —Heat-Treatment of Armor Plate and Impact Testing Also Discussed

THREE months ago local organizations of Steel Treaters near by New York met with their national officers in the first regional meeting. Last week (May 25 and 26) Pittsburgh entertained similarly. And a very successful meeting it was; somewhat more pretentious than its predecessor, it carried technical sessions over two days, and included a rapid excursion through the Edgar Thompson plant of the Carnegie Steel Co. and the extensive Westinghouse works at East Pittsburgh.

Friday evening a banquet was served to about 200 members at the University Club. Dr. John A. Mathews, president of the Crucible Steel Co., was the principal speaker, and as usual drew upon his rich experience and knowledge of the manufacture and properties of fine steels to present some wholesome advice to the younger men.

Recalling that in his brief life he had witnessed, or had participated in, almost every new application of science to the testing and heat-treatment of tool steels, he predicted that the advances of the last 20 years would be surpassed in the next decade. Therefore it was necessary for the ambitious men to keep their minds open to general science, read widely, and build up a mental card index of references to practices in allied industries and sciences. Such references can often be put to use by their owner in the most surprising manner.

Furthermore, he warned against shackling progress by too much standardization. A standard is useful in many ways, but it is tacitly assumed to be the best, not only the best that has come before, but the best that will come after. Once a standard is fixed, every effort is made to suppress variations; yet only through the study of variations can progress be made! While he had every reason to sympathize and co-operate with a progressive works which had fixed upon a certain kind of tool steel for a certain operation, and was determined that those tools be made as nearly alike as possible of exactly the same material, he was opposed to any body of men insisting that the same steel and the same tool should be used for all shops doing that kind of work. Even tool steels were not well enough known to permit such rules being followed, although tool steels had been made since steel was invented, and many manufacturing operations had been agreed upon as best practice long before science had for good reasons approved those same operations.

Fiber in Steel

Prof. F. F. McIntosh of Carnegie Institute of Technology gave an address before the technical session on "Fiber in Steel and Iron." His lecture noted that metallurgists seldom considered fiber of importance. It was therefore a little-studied subject—in fact so little was known about it that there was no precise and accepted nomenclature which could be used to describe the known facts. Yet it would often be impossible to produce tough forgings of intricate shape without careful attention to fiber.

Fiber was often studied with the aid of deep etching reagents, suitable for revealing macrostructure. If such etching developed in a forged piece a well-defined, parallel structure similar to a bundle of very fine wires, which "wires" suffered no abrupt change in directions or foldings back upon themselves, then the piece under overpowering load would be expected to tear apart slowly and exhibit a fibrous fracture, and it was said to possess "fiber." If these conditions were not met, fractures would favor the folds in the macrostructure, often under low loads, they would occur almost instantaneously, as in brittle material, and the fracture would be crystalline. Prof. McIntosh exhibited a series of macro-etchings to support his contention that this fiber could be traced back through all the manufacturing processes into a characteristic dendritic structure in the ingot. It appeared to be absolutely independent of the chemical analysis, as ordinarily performed, and seemed to originate in the way the steel was deoxidized and the conditions during ingot cooling. How the steel making conditions affect dendritic structure is not known with sufficient precision to warrant generalizations, but since selective freezing of iron from melts containing substances of varying solubility is responsible for the cored dendritic structure revealed by deep etching, the same foreign substances—substances which are not iron, even though perfectly normal constituents of commercial steel—are in some way responsible for the production of fiber in the finished piece.

It is important, as E. J. Janitzky, of the Illinois Steel Co., pointed out, to note a line of demarcation between the amount and kind of interdendritic segregates responsible for fiber—if such be accepted as the cause—and that amount or kind which is thought to be responsible for "woody" fractures, so called. Woody fractures are fibrous to the extreme, they occur in steels having extremely low transverse ductility, and are to be avoided altogether. He called attention to a German war specification demanding fibrous structure for crankshafts. It has been contended that an electric furnace which first works up an oxidizing slag, then follows it with a reducing slag, will produce metal with fiber, whereas one which makes up two reducing slags only will produce steels markedly deficient in this elusive property.

W. B. Crowe, of the Carnegie Steel Co., agreed that fiber, laid in a proper direction, was an essential to steel which must pass a ballistic test. He confessed that he was much mystified by the subject, even after many years' study. Two armor plates of the same chemical composition, manufacture and heat-treatment—at least as near as may be in practice—might differ markedly in fiber, even though the one lacking fiber might have superior tensile strength and 65 per cent reduction in area. Furthermore, size of specimen would have much

to do with it. One steel might exhibit fiber in specimens as large as it was possible to break under a press, yet another exhibit fiber only in relatively small pieces. Certainly foreign matter (often called sonims) has much to do with the problem.

Armor plates which fail under the ballistic tests will often be found to contain dirt accumulated along definite, continuous laminations, or on the other hand may be found to be very clean steel. Best results seem to be had when the sonims are uniformly distributed in tiny particles with no continuity of arrangement.

Heat-Treatment of Large Masses of Steel

Continuing on the peculiarities shown in the way large blocks of metal respond to heat-treatment, Mr. Crowe said that the chemical composition had a great deal to do with it. For instance, chromium-vanadium, nickel-chromium and nickel-chromium-molybdenum steels containing 0.45 per cent C in big slabs, 12 in. thick, might be quenched in water from a correct temperature, would exhibit a fine porcelanic fracture for a depth of 3 to 4 in., with the interior semi-porcelanic, and be unmachinable throughout. If these same steels were air-cooled from above Ac_3, they were still unmachinable, and when drawn to give 20 per cent elongation would have quite superior physical properties. On the other hand, similar slabs of a 0.55 plain carbon steel and a 0.40 C chromium-molybdenum steel, when water-quenched from temperatures which in 1-in. test-bars would give the same results as 1-in. test-bars from the other alloys, gave a fine granular fracture at the surface, gradually coarsening to a medium fine grain at the center, and were machinable throughout. In particular, the 0.40 C chromium-molybdenum steel, quenched as a 1-in. bar from 820 deg. C., gave Brinell hardness corresponding to a strength of 300,000 to 325,000 lb. per sq.in. A similar bar cut from a quenched slab gave 140,000 lb. per sq.in. at the surface and 130,000 lb. per sq.in. at the center. If the slab were quenched from 875 deg. C. or 1,050 deg. C., there was no distinguishable difference in fracture, and the uniformity in strength surface to center (as indicated by the Brinell machine) was remarkably constant.

These notes were given as specific instances that laboratory experiments were a poor guide when selecting the temperatures for heat-treatment of large masses. Usually the metallurgist had the opportunity of using one steel which would give the required physical properites after a simple drastic treatment, or another which would require a complex, mild treatment. In general, the former is preferable, if it will produce a high percentage of acceptances, and leaves the unacceptable pieces sound and in shape for a re-treatment. On the other hand, if many pieces are ruined, it would be well to go over to the complex treatment. In any case, uniformity in practice should be the aim.

Quenching by water sprays may be hazardous from many causes, and may be superseded by a different steel quenched in oil, air, or hot water. Laminations and welded blowholes appear to be particularly active causes of quenching cracks; they seem to prevent the uniform conduction of heat through the steel. Sometimes such materials can be handled by quenching to just below color.

It is especially necessary to heat cold slabs very carefully and slowly up to 350 deg. C. in order that they may pass through the brittle range without spontaneous fracture. Complete saturation at high temperatures is quite essential; a good rule for slabs is to allow 1 hour per inch of thickness to heat, and then 40 minutes per inch to soak. Bars take only half this, cubes and balls one-third. This lag in heat, surface to center, is especially vexatious in quenching operations. Often it may be taken care of by quenching from a considerable temperature above the critical; then the lag occurs before the transformation range is reached, and it is then crossed at sufficient speed to produce the hardening effect. This practice may coarsen the grain size, and require an extremely long refining heat just above Ac_3. Recrystallization may be speeded up by reheating 100 to 125 deg. C. higher. If this grain is still too large, the next refining may be 50 deg. C. lower; the crystal grain is thus "stepped down." Ordinarily the piece should be quenched only after the last heat.

Impact Testing

J. M. Lessels, of the Westinghouse company's research staff, read a paper on impact tests, in which he remarked that their laboratory was making satisfactory use of the Izod machine. It appeared to be quite sensitive to changes in quality in the metal, and in hardened alloy steels seemed to vary as some function of the reduction of area. He was careful to emphasize that the Izod test was a measure of notch brittleness, and should not be used to measure the endurance under repeated and alternating stresses.

Much discussion was forthcoming on this paper, mostly from those who were uncertain as to just how to interpret impact tests. Some speakers objected to testing steel in a notched condition, when designers carefully avoid notching their material. Others alluded to the difficulty in getting notches precisely alike, and in eliminating other sources of instrumental error. Attention was called to recent work on Sulphur in Rivet Steel[1] which demonstrated that Charpy and Izod tests would not give consistent results on very uniform steel, and these notched bar tests were totally at variance with impact shear on unnotched specimens. The Stanton repeated impact test was recommended by R. J. Allen, of the Rolls-Royce Co., and was described as a method which in his experience had been successful in picking out steels which in severe service actually gave superior results.

Abrasion Resistance

Preliminary results obtained from a machine designed for the R. D. Nutall Co. to measure abrasion resistance of gear steel was presented by A. M. Cox. It consists of a pair of motor-driven manganese steel rollers 3 in. diameter and 1 in. face set with a little clearance, one geared to run at 300 and the other at 330 r.p.m. In the crotch between these rollers is placed a test roller, 1 in. diameter, which in turn is pressed down by a weighted idler. The effect of the combined rolling and slipping abrasion is noted by weighing the test-piece after a counted number of revolutions. In general, the loss in weight during short runs on a roller varies directly with the number of revolutions. Furthermore, the most abrasive-resisting steel appears to have a medium hardness, although runs on different samples, in what are thought to be identical condition, do not check one another as well as might be desired. A first result of these tests has been the selection of a particular type of steel for gears to follow manganese steel pinions, a selection which has turned out to give extremely good results in heavy machinery.

[1]Reviewed last week in CHEM. & MET., p. 1019.

The Business Side of Chemical Manufacturing

Article Four of This Series—The Study of Marketing Completed With a Study of the Following Departments: Sales Research, Credit, Traffic, Collection, Sales Service — A Discussion of the Theory and Practice of Those Departments

BY CHARLES WADSWORTH, 3D.

MARKETING is not finished with Advertising and Sales. There are five other functions which deserve at least a brief consideration. If you will recall the diagrammatic analysis of Marketing appearing in the second article of this series, we differentiated the following functions:

1. Locate the market.....Sales research.
2. Interest it in the product.....Advertising.
3. Classify prospects .....Credit.
4. Consummate sales .....Sales.
5. Deliver the product.....Traffic.
6. Collect the bill.....Collection.
7. Keep customer satisfied.....Sales service.

The two most important units—Advertising and Sales—have already been discussed in Articles II and III of this series, and this article will complete the study of marketing by taking up the five minor departments in the order mentioned.

Before actually discussing any of the departments, it is extremely important for us to remember our general attitude on the whole subject of organization. Of necessity, we talk of these units and sub-units of organization as departments, but in many properly organized manufacturing companies they may not be departments at all. The work which such a department would undertake may actually be done for some particular company by one man who is a clerk in another department. It is, therefore, not the actual unit of organization which we are discussing, nor yet the actual creation of such a unit of organization. It may be entirely unnecessary. What is necessary and vital is that the functions which the department or sub-department carries out shall not be neglected in any organization. The company with which you are connected may have no credit department whatever, but the sales manager may have given all the thought that is necessary to the credit problem. You would find, if you examined the bills which the company sends out, stated terms, and you would also find that the company dealt with no one who was not actually known to the sales manager. Such a condition would eliminate the necessity of a credit department, but the idea behind the credit department has been entirely taken care of within that particular organization. Illustrations such as this could be multiplied ad infinitum. The point to bear in mind in all this work is this: Do not think, when credit department is discussed, or any other department for that matter, that it is necessary for your company to have a small room with "Credit Department" lettered on the door and a credit man inside. What is necessary, if your company is balanced and healthy, is that the functions of the credit department shall have been considered by somebody in the organization, and a definite policy established. This applies to all the various departments that are differentiated, and it is important only to emphasize it and reiterate it here because we are about to discuss departments which are frequently of minor or of negligible importance in chemical manufacturing businesses. No generalization of the subject is warranted or safe, except that the functions represented by each department named should have been taken care of. This much and no more!

SALES RESEARCH OR SALES ENGINEERING

Perhaps the difference between the marketing problems of the firm which manufactures for the ultimate consumer and those of the firm which manufactures for industry consumption is most apparent in this particular work of locating the market. In the case of the former, the location of the market can be undertaken by the advertising department or the advertising agency. The problem is one of consumer advertising and its solution needs no technical assistance. Expert advertising experience must be focused on the appeal to John Jones, average citizen. The market is known. The sales research problem is the study of the product and the psychology of its consumption. It is an integral part of planning the advertising campaign.

Not so with industry consumption. Sales research is not part of the advertising work. The problem may be one of two, to find uses or new uses for a product, or to develop prospects who would be interested in a product. These problems need technical training for their solution. And in fact sales engineering departments are invariably technical departments.

For administrative purposes these are usually tacked on to the sales department and the head of sales engineering will report to the sales manager. Before we go any further it is necessary to record the sad fact that this department is not widely used. This unfortunately does not mean that it could not be widely used, but rather reflects the conservatism and lack of imagination of manufacturers generally. It is at once apparent that sales engineering would vary over an almost unlimited range.

To take concrete examples of departments which are working on one of the two problems studied by this department. There is first the company which produces, for example, a metal. The sales engineering department of such a company will list possible uses of the metal as they are discovered. The metal might be used in lining equipment such as stills, pipe, valves, etc., or it might be used to make the whole still or valve. There might be a possible outlet in lining cans, in making laboratory or kitchen ware, as a wire for screens, in shingles or spouting for houses. The technical difficulties of each particular use are then studied, the limitations and advantages, the relative cost and the extent of the market. In addition, of course, trade prejudices and sales difficulties must also be evaluated.

Thus the sales research department is or should be in a position to recommend a logical market for the product.

Another company manufactures a machine for a specific purpose—a mill, perhaps, for grinding materials. The sales engineers in this company must locate new industries or firms which could advantageously use this equipment. Can their mill accomplish the results desired in that process? Is it applicable to ore or pigments or to both or to neither? A distinctly different kind of problem from the first type.

Technical Brains and Sales Problems

The point is this: In chemical industries the need of technical brains on sales problems is imperative. That is practically what sales engineering means. The sales manager may recognize this necessity, but the general average attitude is more nearly represented by the following anecdote. The story is not a single occurrence, but has been confirmed a number of times, so that it represents a composite.

The sales manager of a company was asked if it wouldn't be rather a good idea to market a given product in a different form. "Yes, undoubtedly," he replied, "but we have to sell what the manufacturing department produces." That seemed to settle it until the works manager remarked that it would be a much easier proposition to make that same product in the revised form, but he added, "You know we have to make what the sales department can sell." And there you are!

There are a great many chemical firms which might not need to create the department of sales engineering. They could handle the problem through a technical man in the organization, but there isn't a single firm that can afford to neglect the problem. Perhaps this will make some of them realize that the problem exists.

Credit

Among firms which have credit departments you will find it an unpopular department. The salesmen, who are usually the loudest talkers, are forever claiming that the credit department interferes with their work, that it is foolishly conservative and that it pays no attention to salesmen's recommendations. All of these things may be true, but it is largely a necessary and fundamental difference of point of view.

The credit department functions will vary over a limited range. It differentiates first of all between desirable and undesirable customers—those who pay promptly, those who do not and those who do not pay at all. It frequently has control over the terms of sale and can vary them with the customer. For example, a customer who is slow pay may be requested to pay cash on receipt of bill of lading. Often the department has charge of collecting bills, of which more anon.

In chemical industries the importance of the credit department will depend on the nature of the business. A firm which sells in large quantities to firms with fairly large capital will often find that a single sales clerk is all the credit department it needs. On the other hand, a firm which has thousands of customers buying often in small quantities may find that an alert, active and necessarily large credit department is essential to its very life.

The trouble in the industry has been that not enough attention has been paid to the department or to the point of view that the credit man would have. A good credit man will do more than act as curb—he will indicate desirable customers so that the sales department can turn its sales effort to best advantage.

Sources of Information

It does seem rather ironical that, after all the effort of producing and marketing, a firm has to be careful of the customers to whom it distributes. But experience, the oldest teacher in the world, has created the credit man and demonstrated his usefulness, and experience trains him in his work. There are many sources of information open to the credit man, but unless he is able to read the story behind letters, figures and opinions, many a sale will be lost through overconservatism or a large "bad debt" item will accumulate through lack of proper conservatism.

A comparatively large number of business men and even technical men are familiar with the almost miraculous compilations known as Bradstreet's and Dun's. These companies furnish an annually revised list of business houses with an easily interpreted credit rating, expressed in terms of capital and promptness in paying bills. In addition they stand ready to report on the credit rating of any firm to their subscribers.

Trade associations to which the manufacturer belongs may in some cases be able to furnish credit information about a consumer of that industry's material. The National Association of Credit Men is another source of information, while perhaps the most valuable of all, though necessarily limited, is the bank with which the firm is a depositor. Bankers are more and more coming to realize that such service is most desirable from their standpoint. Bad debts contracted by a depositor weaken one of their units. Good accounts correspondingly strengthen them. Bankers obtain this information by co-operating with correspondents in other cities.

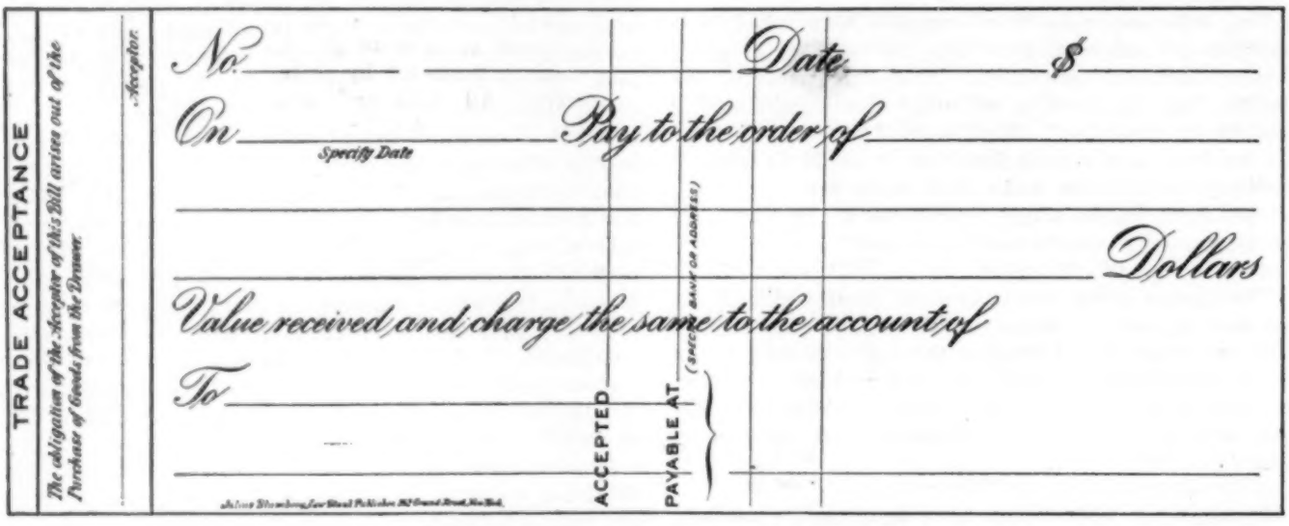
Finally, salesmen often are extremely serviceable in obtaining opinions and forwarding their own estimates of credit reliability.

So information comes in and accumulates. As the firm (and the credit department) grows in age its own experience with customers translates itself into invaluable credit data. It should be recorded—and often isn't. A card catalog constantly revised as new data are obtained is the most convenient record for this material. Such a catalog, usually classified geographically (as Bradstreet's is also), should contain all relevant information such as capitalization, credit rating in Bradstreet's and Dun's, all other credit ratings, salesmen's estimates and finally the detailed experience of specific negotiations with the customer. Date of sale, amount of sale, terms, date account was due, date paid, history of collection follow up if necessary. Frequently elaborate data are not thought necessary, and no generalization is wise in this connection.

Terms of Sale

Fortunate is the firm, wisely financed and successfully managed, which is able to discount its bills. Under our present system American business houses run what is known as an open account with their customers. A sale of material is made and the purchasing firm is billed for the amount of the sale in accordance with certain somewhat arbitrary terms. It is nearly a universal practice to allow a discount of 1 or 2 per cent for cash within 10 days (or some definite short period of

time). To take advantage of this is to "discount a bill." The bill becomes due at its full value within 30 or 60 days and such terms are expressed as 2/10/30 or 2/10/60, which means 2 per cent off for cash within 10 days, net cash due in 30 or 60 days respectively. These terms are generally not rigidly enforced. In fact the laxity of enforcement is notorious. Cash discounts are taken without protest at 15, 20 or 30 days where 10 days is allowed. Accounts due in 30 days run on 60 and 90 days without more notice than a monthly statement. This laxity is a subtle and bad influence on general business. Nothing is more quickly demoralizing than slackness in financial matters. It is rather a mistaken idea that it is a favor to the customer to let the time dates on which bills are due slide by unnoticed. As a matter of fact, it works the other way, and a company which demands fulfillment of terms in a friendly but definite way will usually command the respect of the customer. Leaders in finance have frequently given this subject attention, and it is one of the concomitant blessings of the trade acceptance system, made possible by the Federal Reserve Banks, that a higher standard of financial responsibility is certain.



FAC-SIMILE OF A TYPICAL TRADE ACCEPTANCE

The Trade Acceptance

This section is, I unblushingly confess, propaganda. Aside from the distinct financial advantage to the individual firm which uses trade acceptances, the general economic advantage to the nation is great enough to make it an almost patriotic duty to present the subject forcibly. The trade acceptance became a commercial possibility in this country when the Federal Reserve banking act was passed. This provided for minimum rate of discount on trade acceptances. In order to become eligible for this low rate of discount under the Federal Reserve act, "the bills must be the result of commercial transactions" and the proceeds must be "used for agricultural, industrial or commercial purposes." This wording was intended specifically to exclude the possibility of using the proceeds from trade acceptances in speculation.

If you will examine the fac-simile of a typical trade acceptance on the accompanying cut, you will see that it amounts to a promise to pay on a certain time, usually 60 or 90 days distant from the date of issue. The acceptance is issued by the firm selling the goods and is "accepted" by the buyer, who then designates the bank where it will be paid. The form is then returned to the seller, who can keep it until maturity or, if he needs cash, take it to his bank and have it discounted. This means that he will receive the face value of the trade acceptance less the small discount permitted by the Federal Reserve act. Under our present system of commercial banking, when funds are necessary, a firm goes to a bank and asks for a short term loan. If the firm's standing is good and if the bank has money to spare for commercial loans and if the money market is not tight, the loan is made. Now, if trade acceptances were used, it would remove the arbitrariness of the present system.

There is another very good influence which trade acceptances would have on business in general. Under the lax collection system of open accounts a firm is very apt to overbuy. With trade acceptances, however, the fact that the money is due on a definite date and must be paid when the bank presents the note would compel clearer and more intelligent thinking on commercial problems and a firm would not overbuy on the chance that it could let its open accounts ride along until money came in to cover them. This has proved fatal so often that it would be very desirable to supply the ounce of prevention against overbuying and other lax practices. There would be no advantage gained by offering cash discounts under the trade acceptance system, and hence the illogical cash discounts would disappear. Cash discounts at best are a very lukewarm plea for prompt payment, while trade acceptances provide a 100 per cent efficient mechanism for the same purpose. Banks are unwilling to risk loans to small firms in anything like the same proportion as they will to large firms. This, of course, is not unnatural, but it frequently works great hardship on the smaller firm. This hardship completely disappears if the trade acceptance is adopted, for a trade acceptance is as easily marketed by the small firm as by the large.

In addition to helping the individual firm, it is also of great assistance to the commercial bank. A very great many failures in commercial banking circles have been due to the fact that commercial loans were not sufficiently liquid and in times of financial stringency collections on maturing loans could not be made. This

situation would be greatly relieved by the use of the easily negotiable trade acceptance. It is, of course, perfectly obvious that when a firm asks for a loan from a bank it would ask for a fairly large amount. Trade acceptances, on the other hand, would spread this amount over a number of smaller units. In this way, the assets of the bank are very much easier to liquidate than they could possibly be under the loan system. If you multiply this by the number of banks, you will see how infinitely more flexible the credit machinery of a country becomes. Financial stringency under a trade acceptance system would be almost unbelievable.

Traffic

It is a wise plan to avoid generalizations if possible. It is wise because it is very easy to drift into a habit of loose generalization which is inaccurate and misleading. After due consideration, however, it is safe to say that the traffic work of most companies can be handled by one man in part of his time. It is also safe to say that this work is neglected by many firms to their own disadvantage. The traffic department varies somewhat in proportion to the size of the freight bills. It will thus be obvious that a heavy chemical plant is more apt to have a large traffic department than a fine chemical plant. If finally the company owns and operates its own tank car service, the traffic department becomes a major department in every sense of the word.

The department is occupied with three questions: The first one is, what is the cheapest way of routing material to its destination; the second, locating and tracing of shipments to and from the plant; and the third, the collecting of claims against the railroad or transportation companies.

The work of the department is largely routine after the system has been worked out, even in companies which have large traffic departments. In fact, the very success of the department depends on the rigid following of routine. This statement goes double in case any exporting is done. Then routine is verily canonized, and necessarily so. That subject is far too intricate for casual consideration.

Railroad Rates

There is one thing which rather impresses a man who takes up traffic somewhat seriously, and that is the work of the Interstate Commerce Commission. Our railroad rate system is rather a peculiar jumble. Before there was an Interstate Commerce Commission railroad rates were not standardized. They varied to different shippers and preferential rebates were common. Gradually some order has come out of chaos, as much order as could come from a system which has been produced by expediency. At risk of developing a point which may be familiar to many, let this serve as an illustration of what is meant. Assume a flat rate per mile of transportation, and then have clear sailing and a progressively increasing rate from New York to St. Louis, Kansas City, Denver, Salt Lake City and San Francisco. But in transporting to San Francisco the railroads encounter water competition. If they are to stay in business they must meet water transportation rates. This means a substantial diminution in the New York-San Francisco tariff. It therefore becomes cheaper to ship from New York to San Francisco by rail or boat and then reship from San Francisco perhaps even as far as Salt Lake City. In other words, the freight rate from New York to Salt Lake City may actually be more than that from New York to San Francisco plus that from San Francisco to Salt Lake City. It is at once obvious that the Interstate Commerce Commission would have a nice question to decide as to whether or not this would be equitable. This is one of the many kinds of complications which arise. The decisions of the I.C.C. have been impressive for their thorough and detailed study of difficult problems. It is easy to criticize. It would have been nearly impossible for the system to develop otherwise than it did.

Need of Discretion by Traffic Man

Naturally in a traffic department some familiarity with freight tariff and with general methods of transacting railroad business is necessary, but it is not an unmixed blessing. In one case an overpowering desire to avoid demurrage charges cost the company a good deal of money. Cars were unloaded in order to clear them from the yard and the material had in some cases to be transported to a consumption point within 3 days. A small demurrage charge would have avoided the large charge for transferring the material. So while intimate knowledge of railroad procedure is highly desirable, it should be tempered by some personal or executive restraint. All these problems which the traffic department has in hand deal with railroads principally, except as noted in case of export and except further when it is considered desirable to use motor truck transportation. Frequently a separate clerk, group or executive will have charge of the trucks and be attached to the sales department rather than to the traffic department, which seems somehow to be inseparably and often solely concerned with railroad work.

Collections

The problem which we are about to discuss has very little of vital interest to chemical-manufacturing companies. The reason for this is that most companies do not sell to the individual consumer. Their product goes to firms of relatively high financial standing, and as a general thing, no policy of collection is considered necessary.

There are inevitably bad debts, but the percentage is less than in the case of firms which market to the ultimate consumer, and are more easily avoidable. In other words, the customer who does not pay his bills is easily differentiated, and no more material is sent to him.

There is, however, a valuable point to consider in connection with this work. The normal course of collecting bills involves the sending of statements, at first merely stating the amount due, then perhaps with a "Please remit" stamped on the statement. This is followed later by a polite letter, calling the firm's attention to the fact that the bill is due, and this in turn may be followed by a rather impolite letter, threatening legal action. Finally, it may be necessary to turn the account over to a collection agency, where for a rather large commission the disagreeable task of squeezing the dollar out of the stone is undertaken. This procedure is carried out thoughtlessly and mechanically, and little consideration is given to the individual needs of the case. Not infrequently an unfortunate attitude is developed by a customer due to the rigid application of the system. Consider this from the point of view of an individual. The tactless and needless use of a large "Please remit" stamp has frequently been the cause of a change on the part of a customer. Business houses must remember

that collecting bills must be done tactfully and not mechanically. You are dealing with personal reactions even though they are masked under a firm name. This is one of the points of contact mentioned in the discussion of advertising which must be watched carefully to avoid any bad reactions from firm policy.

Sales Service or Trouble Department

The exact point at which the sales research department ceases to function and the trouble department begins is somewhat difficult to decide, but the functions are definite and distinct except on the border line. The process of locating a customer may involve and frequently does involve the confident knowledge that he will be satisfied with the product. In that sense, therefore, the sales research department is not dissimilar from sales service. Both, furthermore, are technical departments which must be operated by technical men and both represent the opinion of technical men with regard to the sales department, though, to be sure, the attention is focused on different points.

Trouble Work Should Be Under the Direction of the Sales Department

The inception of a sales service or trouble department can be rather easily described. A complaint comes in to a manufacturing concern. Some material was not satisfactory. "Why not?" asks the general manager. "Well," suggests the sales manager defensively, "the operating department really knows more about the product than I do. I suggest that they be asked to find out." This sounds logical, and the general manager therefore usually calls in an operating man, who is given this specific job of settling the complaint. In a large organization these complaints are not infrequent and therefore it may be that one of the operating men will work into trouble work. Of course it is a wrong theory for the sales department to shunt it off on the operating department. The work should be done under the direction of the sales department and in chemical firms particularly this is frequently not the case. The operating department has no sales background. It is difficult or practically impossible for the technical man to sense and reflect the policy of the sales department toward that particular customer unless co-operation is close, which it usually is not. The result is that wires frequently get crossed and wrong attitudes are developed by the customer, all of which might be avoided if the sales department were not usually so anxious to get rid of a distasteful job. This last phrase is put in advisedly and after careful thought and lengthy observation. The trouble department is so frequently not included under the jurisdiction of the sales manager and so frequently the distaste of the sales manager for this kind of work is evident that the statement represents an existing condition.

Too Few Chemical Concerns Have Trouble Departments

We have been talking about firms which actually have trouble departments and unfortunately we are talking about a relatively small percentage of chemical manufactures. Trouble departments are almost as unknown as sales research departments. There have come personally to my attention not a few firms large enough so that many complaints are received, yet without anyone to take an interest in this work. The inevitable result has been that many a customer has turned to competing firms when a little sales service work would have kept him in a friendly frame of mind and ironed out the particular technical difficulties.

There is the whole crux of the value of sales service. Technical difficulties are frequently encountered by the consuming industry and these difficulties can be overcome oftentimes by co-operation between the seller and the buyer.

Naturally the buyer, if he has experienced trouble with a product, is not likely to be enthusiastic about repeating an order. It is therefore a matter of dollars and cents to the seller to make sure that trouble does not arise from his own product and to make the buyer realize it. This logic seems to me to be the most elementary kind of reasoning and yet many sales managers in the chemical field still rely upon a kindly pat on the back and a good cigar to dispel technical troubles for their purchasers. A definite attempt is made to minimize the trouble, to make the purchaser believe that after all he really is not in trouble and if he is, that it can't be the fault of the product. Such an ostrichlike attitude can really not be tolerated in technical manufacturing and a firm is biting off its own nose if it does not see that the information which it obtains itself from trouble work is of the utmost importance in developing better products, more easily marketable and more serviceable to the industry to which it is selling.

Desirability of Technical Work

It is often not easy to point out the desirability of technical work. It has been especially difficult during the last year when firms have been cutting their technical staffs to an absolute minimum, but in the case of the sales service or trouble department, the necessity of undertaking this kind of work is becoming more and more evident, even to the rather conservative industry to which we belong. Very interesting sales service departments are to be found in most of the progressive dyestuff manufacturing companies. An effort is made to have on the sales staff of even small producers of dyestuffs men thoroughly familiar with the dyeing game. Sometimes it has been found necessary to train specialists in such things as the dyeing of paper and other special branches, but in nearly every case you will find a man in the organization who can go out and show a dyer how to use the company's dyestuffs in the plant. If only the rest of the dyestuff industry were as admirable as the sales service departments we should have nothing but praise for them. Heavy chemical manufacturers specifically can take a valuable lesson by studying this particular work. Heavy chemical manufacturers have been notoriously slow to believe that anything like trouble work is essential or desirable and, in fact, there are hardly any manufacturers of this class who make a practice of finding out whether their products fulfill the requirements of the customer. True, when complaints come in, they are frequently taken care of, but there is no systematic effort to find out whether the technical man in the consuming company is satisfied or not. Until this state of efficiency is reached the sales department may be said to be standing on relatively unsubstantial ground.

NOTE:—This is the last of the series of articles on the Marketing Function. In subsequent issues several articles on Accounting and Cost Finding in chemical manufacturing will be published. They will complete this series on the business side of chemical manufacturing.

The Manufacture of Ammonium Nitrate

Description of Modern Operating Practice and Considerations Affecting Design and Operation of Ammonia Stills, Scrubbers, Condensers, Neutralizing Tubs, Evaporators and Crystallizing Kettles—Use of Ammonium Nitrate in Permissible Explosives

By E. M. SYMMES
Chemical Department, Hercules Powder Co.

THE use of ammonium nitrate in explosives is becoming of more and more importance every year. Approximately 20 per cent of the sum total of the commercial high explosives made in this country each year consists of ammonium nitrate. This amounts to a very substantial figure, and small economies in yields or plant costs in the manufacture of ammonium nitrate are important items when the total is considered.

At the present time there are two sources of supply of ammonium nitrate available—one the synthetic product from Norway and Germany, the other a product made by neutralizing ammonia gas derived from coke ovens with nitric acid made from Chilean saltpeter. Synthetic ammonium nitrate shows a purity of 99 per cent or better on the dry basis and usually contains about 0.10 to 0.15 per cent of moisture. It is received in large casks, usually solidified. It is treated by breaking it out of the casks and subjecting it to a coarse grinding in a swing hammer mill, followed by heating and agitation in a steam-jacketed crystallizing kettle to reduce the moisture to 0.05 per cent or less and simultaneously to wear down the crystal structure until a fine meal is obtained, suitable for direct use as an ingredient of dynamite and gelatin.

The ammonium nitrate made from ammonia gas and nitric acid is obviously a product of the following reaction:

$$NH_3 + HNO_3 = NH_4NO_3$$

which expresses the essential features, although water is present on both sides of the equation as a diluent for the sake of convenience in manufacture.

Effect of Impurities in Ammonia on Yield

Most grades of ammonia liquor from coke-oven plants contain a number of impurities, the amount depending upon the purification to which it has been subjected. The usual impurities are:

Ammonium sulphide $(NH_4)_2S$.

Tarry bodies, both soluble and insoluble, containing small amounts of pyridine and light oils.

Fixed ammonia salts, such as sulphate, sulphite, thiosulphate, thiocarbonate, chloride, thiocyanate, ferrocyanide and carbonate.

In the direct neutralization processes practically all of these compounds are retained in the neutralized liquor in some form or other. The ammonium sulphide probably reacts as follows:

$$(NH_4)_2S + 2HNO_3 = 2NH_4NO_3 + H_2S$$
$$3H_2S + 2HNO_3 = 4H_2O + 3S + 2NO$$
$$2NO + O_2 = 2NO_2$$
$$2NH_3 + H_2O + NO + NO_2 = 2NH_4NO_2$$
$$2NH_4NO_2 = 2N_2 + 4H_2O$$

showing what a far-reaching effect sulphur has upon the reaction. The losses may be calculated on the basis of the above reactions as follows:

$2HNO_3 = 126$ molecular weight
$3S = 96$ " "
$2NH_3 = 34$ " "

therefore 1 lb. sulphur represents a loss of 1.312 lb. HNO_3
and 1 lb. sulphur represents a loss of 0.3541 lb. NH_3

One hundred pounds of ammonia liquor containing about 25 per cent NH_3 is worth about $2.75. If it contains 1 per cent of sulphur, then the

HNO_3 lost = 1.312 lb. at 6c. = 7.872c.
NH_3 lost = 0.3541 lb. at 11c. = 3.895c.

Total loss per 100 lb. = 11.767c.

$$\frac{275}{11.767 \times 100} = 4.28$$ per cent reduction in value of the ammonia liquor by 1 per cent of sulphur.

The harmful effects of the above impurities are felt throughout the system. The tarry bodies collect in black clots which float on the liquor during neutralization and evaporation, decomposing and frequently igniting and burning. Free sulphur, with the cyanogen compounds, settles out during storage of the neutralized liquor, and if not removed is a source of fires if drawn into the evaporation process. The reaction is probably as follows:

$$2S + 8NH_4NO_3 = 2SO_2 + 2NO_2 + 16H_2O + 7N_2$$

and $$S + 2NH_4NO_3 = (NH_4)_2SO_4 + 2NO$$
$$2NO + \text{air} = N_2O_3$$

Economies of Direct Neutralization

At the present time ammonia liquor can in many cases be obtained with the tar and sulphur content as low as 0.01 and 0.05 per cent respectively. Under these conditions it can be neutralized directly by weak nitric acid without trouble from the small amounts of impurities. When liquor of less purity is used, it must be subjected to distillation to hold back the impurities and drive out the pure ammonia gas from both the free and the combined ammonia.

In direct neutralization all the water of the ammonia liquor enters the neutralized solution, and it must be evaporated finally. When using the distillation process, on the contrary, all of the water is retained by a reflux condenser and only the ammonia gas passes into the nitric acid used for neutralization. Consequently, the water of the ammonia liquor does not have to be evaporated in the end. At first glance this would seem to be a substantial economy, but further reflection will show that large quantities of steam, compressed air and cooling water are required for the operation of the ammonia still, which will offset the apparent economies mentioned above. To distill a lot of ammonia liquor of 4,000 to 10,000 lb. will require about 6 hours. To neutralize the same quantity by the direct process without distillation will require from 1 hour to 2 hours.

There is thus a very considerable saving in labor, as well as in steam and air for the still. The over-all economy of the two methods is something which must be determined by local conditions at each plant.

Effect of Impurities in Nitric Acid on Yield

The nitric acid used is usually obtained from two sources—that recovered from denitration of spent acids and that made as the weak portion from nitric acid stills. This weak portion includes both the last runnings and the tower acid. As used for neutralizing ammonia liquor it has a strength of about 45 to 50 per cent. Stronger acids will permit the temperature of the neutralization process to rise high enough to cause decomposition of the ammonium nitrate.

The usual impurities in nitric acid are hydrochloric acid, sulphuric acid and nitrogen peroxide. The hydrochloric acid is derived from the salt (NaCl) contained in the Chilean saltpeter. The ammonium chloride formed from it causes no particular trouble unless present in large amounts, in which case it reduces the strength of the ammonium nitrate as an explosive. The same is true of the ammonium sulphate formed from the sulphuric acid in the nitric acid. The nitrogen peroxide reacts as follows:

$$2NO_2 + 2NH_3 + H_2O = NH_4NO_3 + NH_4NO_2$$
$$NH_4NO_2 = 2H_2O + 2N$$

from which it will be seen that one-half of both the NH_3 and the NO_2 which enter into the reaction is lost. It is therefore desirable that the nitrogen peroxide content of both kinds of the nitric acid used be as low as possible.

All the material used is weighed carefully, and yield statements are made out at the close of each month. On account of the corrosive nature of the vapors in the house the scales used require close attention. The bases are sealed in oil, and when properly constructed will remain accurate for a long period. Frequent and regular checking is necessary if beams and weights corrode. In unheated houses it is necessary to use coal oil for the oil seal, or some low-freezing, thin lubricating oil, to prevent freezing with consequent loss of accuracy.

For the sake of economy the two operations of distillation and neutralization are conducted in the same house, so that one operator can attend to both. In starting the operation the charge of ammonia liquor is drawn into a blow-case from the elevated outside storage, and weighed accurately. This blow-tank has a vent discharging either into the neutralizing tank or into acid-absorption towers to catch the ammonia gas which would otherwise be lost. The same acid-absorption towers serve to catch the ammonia gas from the vents of the large outside storage tanks. The weigh tank has a small sampling valve near the bottom, through which a sample of every weighing is taken. This sample, when composited and analyzed, serves to determine the quantity of ammonia gas charged against the operation.

Purification of Ammonia

Since in distillation it is necessary to break up the fixed ammonia salts, lime is added to the still. The proper amount may be calculated either from an analysis of the ammonia liquor or by tests applied from time to time during the operation to see if a sufficient quantity is present. On the assumption that calcium sulphide is formed by the reaction between calcium hydroxide and ammonium sulphide, as in the following reaction:

$$Ca(OH)_2 + (NH_4)_2S = CaS + 2NH_3 + 2H_2O$$

and with dry CaO = 71.4 per cent Ca, 28.6 per cent O
and with CaS = 55.6 per cent Ca, 44.4 per cent S
1 lb. CaO is equivalent to 0.5704 lb. sulphur.
1 lb. $Ca(OH)_2$ is equivalent to 0.4326 lb. sulphur.

1 lb. Sulphur is equivalent to $\frac{1}{0.5704} = 1.753$ lb. CaO.

Example:

12,000 lb. charge of ammonia liquor containing 0.5 per cent sulphur.
12,000 × 0.005 = 60 lb. sulphur in the liquor.
60 × 1.75 = 105 lb. CaO.
Allowing approximately 25 per cent excess
105 + 25 = 130 lb. CaO.
Assuming slaked lime contains 75 per cent CaO

$$130 \times \frac{1}{0.75} = 173 \text{ lb. slaked lime required.}$$

A check on the proper quantity of lime to use lies in the color or the residue from the still. If white, too much lime is being used, and the excess is wasted. If a light blue, conditions are about right, only a small quantity of the ferrocyanides being left unattacked. If very dark and with an odor of hydrogen sulphide, there is a deficiency of lime and the sulphur and cyanogen compounds are not completely destroyed. Hydrated lime, although commanding a higher price, often makes a saving by reducing the labor of preparation.

The ammonia gas is driven out of the liquor in the still by heating with steam coils and agitating with air, passing the gas first through a reflux condenser to remove the water and return it to the still, and then through a scrubber where it bubbles through a solution of sodium carbonate. From the scrubber the gas goes down to the bottom of a neutralizing tub in which there is at first a shallow layer of weak nitric acid, where it reacts, forming nitrate of ammonia.

Since the lime used in the still cakes on the steam

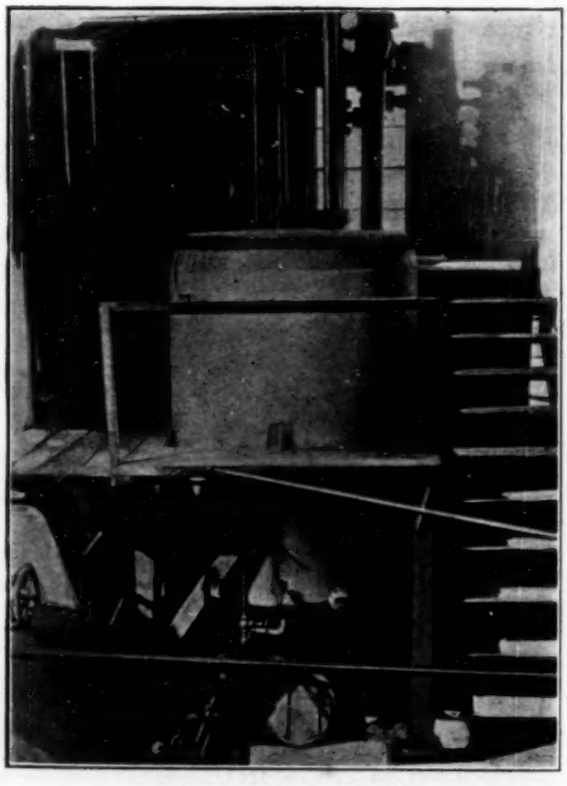


FIG. 1—AMMONIA STILL

coils, reducing the heating efficiency seriously, it is sometimes economical to substitute soda ash, which does not give this trouble.

Operation of Ammonia Stills

The still is always provided with a long manometer made of 1-in. pipe long enough to permit the still to blow out through this manometer at 10 lb. pressure, since if the discharge pipe lines were to become plugged a dangerous pressure would otherwise be built up in the still. If the latter were to burst when filled with ammonia liquor, the conditions can better be imagined than described.

The heat must be applied gradually at first, since the depth of the nitric acid originally in the neutralizing tub is slight, and a rapid evolution of ammonia gas will blow through this layer without being neutralized and will be lost up the stack. For this reason two neutralizing tubs to one still are sometimes provided.

Between temperatures in the still of 130 to 180 deg. F. there will be a so-called "prime," or very rapid evolution of the gas. As the temperature approaches this point the steam must be cut off and the rate of addition of nitric acid to the tub increased so that no ammonia gas will blow through the neutralizing tub and be lost. After the "prime" has passed the amount of air agitation in the still must be increased to carry out the remaining quantities of gas, but too much air will so dilute the gases that difficulty will be experienced in absorbtion.

Operation of Ammonia Condensers and Scrubbers

It sometimes happens that the odor of pyridine present in the still residue masks the odor of ammonia when the latter is present only in small amounts. The sense of smell should not be relied upon. The best method is to hold a strip of moistened phenolphthalein paper over the sample of hot still-residue. A slight purple tinge around the edge of the paper will indicate very small amounts of NH_3.

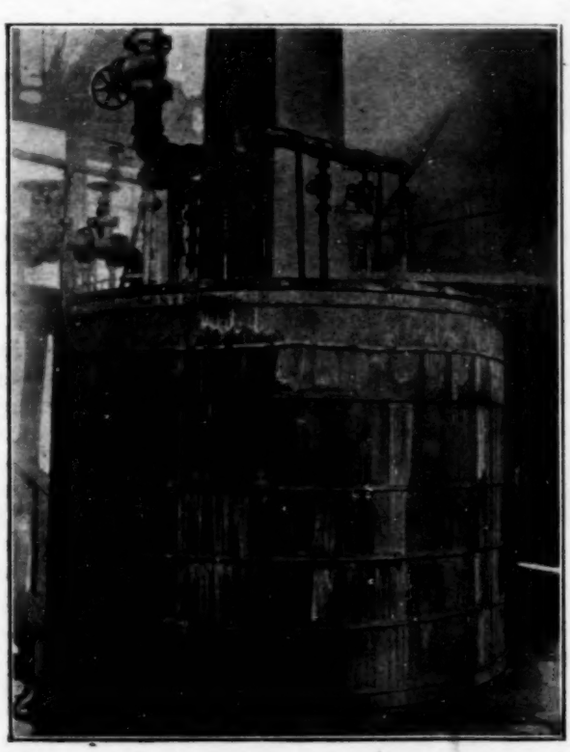


FIG. 2—NEUTRALIZING TUB, SHOWING FUME STACK

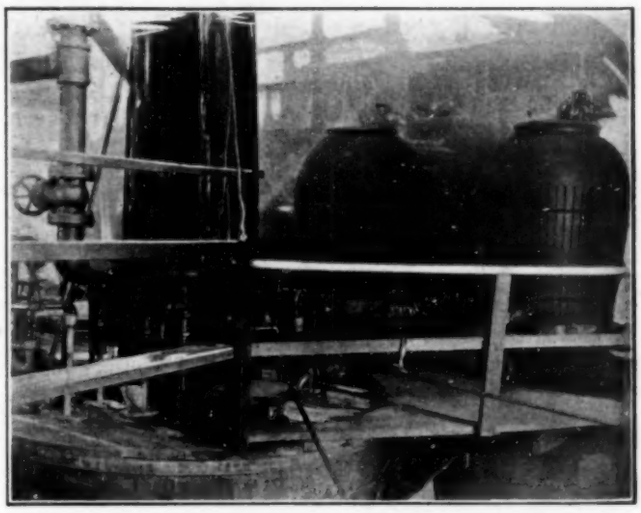


FIG. 3—TOP OF NEUTRALIZING TUB, SHOWING NITRIC ACID SCALE POTS

A condenser, properly operated, should reduce the temperature of the gases to about 120 deg. F., although this will vary somewhat with the temperature of the cooling water used. If temperatures much above this are permitted, the scrubber will fill up with condensate and require renewing.

Unless the condenser is frequently tested for leaks, losses in yields will be experienced, which are almost invariably blamed on other parts of the operation. On account of the large amount of cooling water used, the escape of ammonia gas will not be evident from examination of the water. The condensers should be tested frequently when empty by using a small water pressure.

The scrubber serves to remove any sulphur or tarry bodies which may have passed over. This, theoretically, should not happen, and the scrubber should act only as a flexible unit from which to draw a small amount of ammonia gas to finish the neutralization after all the ammonia gas has been removed from the still. As a matter of fact the scrubber does retain considerable quantities of sulphur.

The solution used in the scrubber is an 8-deg. Bé. solution of soda ash. It should not be stronger, as nothing will be gained and there will be increased opportunity for crystallizing on chilling, which will plug up the perforated distributor pipes in the bottom.

Construction of Neutralizing Tubs

Past experience has shown that hot solutions of ammonium nitrate wear out wooden tanks very rapidly either by permeating the wooden staves or by forcing the staves apart by crystallization in the cracks. To avoid this the tubs are lined with a dense, acid-proof brick set in some acid-proof cement such as Pecora, Fireite, Duro, or something similar.

Formerly tanks were installed with their tops flush with the floor. This had the disadvantage of not showing leaks as they developed, and rendering repairs, tightening of the bands, etc., impossible without dismantling. The old tubs were double—i.e., with an inner, brick-lined wooden tank set inside of an exterior and larger wooden tank, the space between the two being filled with a high-melting pitch. Tanks con-

structed recently are set above the floor level and have no exterior tank, but have small streams of water playing over the staves to keep them wet and swelled, since the heat developed during neutralization will dry the staves very rapidly otherwise. When installing such tanks it is necessary to subject the interior brick lining to a wash of weak acid to set the cement before actual use, since otherwise the cement will not become hardened sufficiently to resist the hydrostatic pressure and heat of operation during the first run.

Many types of gas distributors for these neutralizing tanks have been tried, including long glass tubes with small perforations on the bottom, chemical-ware hub-and-spoke, and Duriron, Tantiron and Corrosiron hub-and-spoke types. In tests of these comparisons have been made to determine life, yields obtained and relative costs both of construction and upkeep. The acid-resistant alloys have proved to be the best and are practically indestructible.

Operation of Neutralizing House

It is important to have as deep a "heel" as possible in the neutralizing tank to start with, and this should be calculated as the maximum allowable without overflowing the tank at the end of the run. Allowance must be made for the differences in volume of the various strengths of acid used. While tests have shown that very high yields can be obtained with comparatively strong acids, their use requires much more care, since the temperature in the neutralizing tub rises more readily in this case and high temperatures are, in general, conducive of low yields. The temperature should never be permitted to rise above 195 deg. F., since above this point a violent frothing occurs with evolution of nitrous oxide and loss in yield.

Each crock of weak nitric acid is carefully weighed and sampled before use, and at the end of the day the various samples are composited according to weights, and analyzed, so that a yield can be calculated monthly not only on the ammonia but also the acid efficiency.

The top of the neutralizing tub is covered, except for a small window for the operator to watch operations and dip out samples to test for neutrality. During the run, methyl orange test papers are used to determine whether a sample removed is acid or alkaline, but at the close of the run the exact end-point is found by taking a known quantity in a pipette, which is neutralized by a tenth-normal acid or alkali solution from a burette, with methyl orange solution as indicator, since this determination is much more delicate than the test papers. After a very short experience the operator can almost entirely dispense with the test papers, since the color of the solution in the tub is indicative of acidity or alkalinity. If a lemon color, the charge is acid, and if a chocolate-brown, it is alkaline. These colors are due to the small amount of iron present, the change being very delicate.

Occasionally during neutralization severe foaming occurs, which, if the tubs are being operated at capacity, may cause them to overflow. A small amount of petrolatum thrown into the tub will float on the top and obviate this trouble.

Recently, advantage has been taken of the fact that the principle of the heat exchanger can be applied to this operation just as easily as it has already been applied to others. If two stills are used, the gases from the one in operation are passed through the idle one, the latter acting as a condenser and also absorbing the heat from the gases which would otherwise be wasted in the cooling water of the condenser.

At the close of the neutralization, the tub is emptied by an acid-resisting cast-iron standpipe connected to a centrifugal pump which delivers the neutral liquor to storage tanks. Formerly the latter were made of wood, but more recently have been constructed of boiler plate, since the latter have the longer life, in spite of considerable rusting being experienced. The small amount of iron rust carried through the neutral liquors is of no disadvantage. In fact, it is a positive advantage in preventing the development of acidity during evaporation, as will be explained later. For this reason agitators consisting of air pipes are installed in these storage tanks to stir up the iron rust sludge and carry it through.

Evaporating Equipment

Experience in evaporation of neutral ammonium nitrate involves a variety of styles of evaporating pans, methods of heating, and theories regarding losses involved. Many shapes of pans have been used, both direct-fired and steam-heated. Steam coils with rust joints inside the pan, through-and-through coils of wrought iron, cast iron and steel, even Spellerized steel

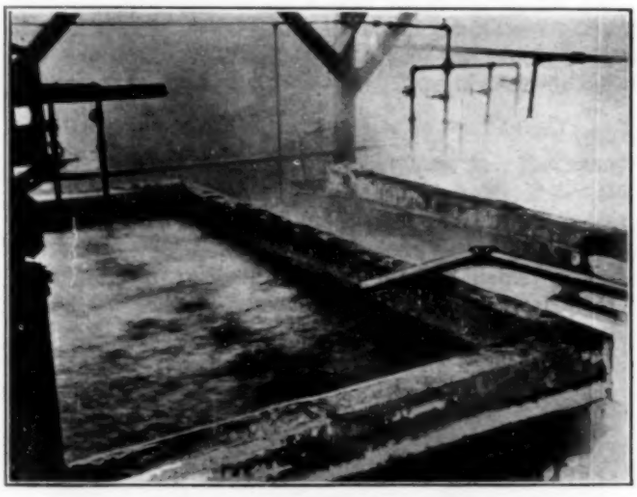


FIG. 4—EVAPORATING PANS

and aluminum, have been used. Experience has shown that in general liquors containing a considerable quantity of ammonium chloride act severely on wrought iron and steel, sometimes corroding through in one evaporation, while cast iron will stand this service. The latter are difficult to obtain in such lengths, and two shorter lengths have been carefully threaded and joined in the center. The air agitation should never be directed against a steam pipe, since the blast of air will cut through a steam pipe in this service in the course of a few hours. While no work has ever been done to prove the point, it is assumed that the air in the hot solution assists in the hydrolysis of the ammonium nitrate, carrying off the ammonia gas and leaving behind the nitric acid, which rapidly corrodes the metal.

One theory of this corrosion of the steam pipes is that the entire pan operates as a huge galvanic cell, the two elements being the dissimilar metals, steel and cast iron, the electrolyte being the ammonium nitrate solution. Insulation of the steam pipes from the pan

and measurement of the potential differences show an appreciable voltage, which supports this contention. Nevertheless, the corrosion does not take place in the absence of ammonium chloride.

Evaporating pans of the size in use at present contain about 8,000 lb. of a solution of about 50 per cent concentration. The steam pipes were formerly one continuous through-and-through coil, which had the disadvantage that a leak in the coil at any point stopped operations. At present there is a steam header at each end and each steam pipe in the pan is fed from this header by a small valve, so that a failure of any one pipe permits cutting this particular pipe out of service without interrupting the operation.

Operating Considerations in Evaporation

At elevated temperatures experience has shown that the loss in yield is directly proportional to the time the solution is held at the high temperature. Evaporation is therefore carried off as rapidly as possible.

The use of air agitation is required during evaporation on account of the severe foaming experienced without it. A slight current of air bubbling through the liquor from perforated air pipes breaks up this froth very effectively. A large air receiver is placed in the air line near the operation to separate the water always carried by compressed air. This reservoir prevents freezing of the air lines in cold weather, as well as insuring a supply of air for some time in case of failure of the main supply. Calculations will show that it is cheaper to install a small low-pressure rotary blower to furnish this air for agitation rather than to use high-pressure air and throttle down to the low pressure required.

It was formerly the custom to add small amounts of chalk or zinc oxide to the charge during evaporation to reduce the acidity developed and so protect the pan from corrosion. On account of the alkaline nature of these substances, ammonia gas was driven off with consequent loss in yields. It has been found that ferric hydroxide normally present in these solutions exerts the same effect without driving off ammonia gas, and therefore additional iron is now added in case insufficient is present.

To illustrate the extent to which losses may occur in evaporation during long periods of time we give below figures obtained experimentally by heating nitrate of ammonia in a constant temperature bath for 2 hours:

Temperature in Deg. F.	Per Cent Loss
330	3.53
320	2.65
315	1.66
300	1.14
290	1.00
280	0.53
270	0.40
250	0.21
230	0.10
210	0.00

On account of the hydrolysis mentioned above, charges can develop acidity during evaporation, but this change can always be recognized by the color of the charge. A lemon-yellow color indicates acidity, which can be confirmed by tests with methyl orange papers if any doubt exists. This acidity during evaporation may be corrected by the addition of the minimum quantities of chalk or zinc oxide necessary, bearing in mind that any excess drives off ammonia gas. The presence of small quantities of iron oxide or hydroxide in suspension will prevent this development of acidity and so protect the pan and steam pipes from corrosion. Small quantities of iron may be added to the neutralizing tub to furnish this hydroxide.

Operation of Crystallizing Kettles

The solution of ammonium nitrate is evaporated to a predetermined point and then drawn off into a water-jacketed crystallizing kettle having revolving arms and scraper blades so that the salt may be agitated during cooling, to produce the size of crystal desired. The determination of the proper temperature to which the solution in the evaporating pan must be carried is actually the determination of the freezing point of the charge. In actual practice some of the solution is removed in a dipper, a thermometer placed in it, and the material stirred by the thermometer while cooling. As the temperature falls, a point is reached where it remains practically stationary for a time as the liquor becomes thick and slushy. This pause in cooling is due to the heat developed by crystal formation. This point, and not the maximum temperature of the solution of ammonium nitrate, is taken as the criterion for the finish of the evaporation. Three factors influence the final size of the crystals obtained, (*a*) the temperature of crystallization, (*b*) the rate of cooling, and (*c*) the amount of ammonium chloride present.

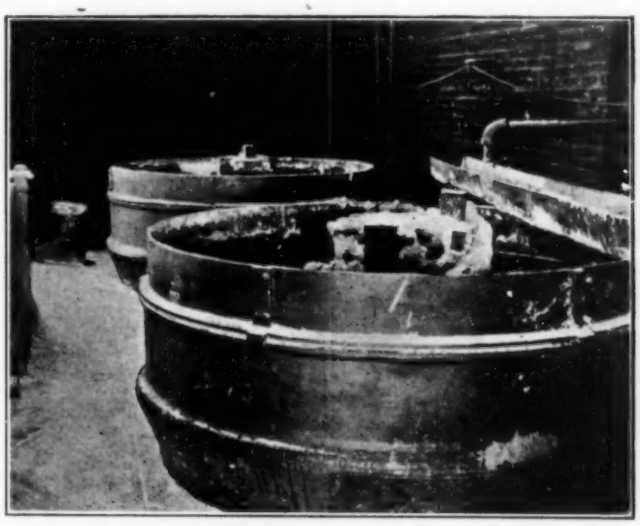


FIG. 5—CRYSTALLIZING KETTLES

Two grades of ammonium nitrate are used in explosives—one a very coarse, sandy material, the other a rather fine powder. The former is made by carrying the evaporation to a higher point and permitting the liquid to run into crystallizing kettles heated by steam in the jacket. After the entire charge is in the kettle the steam is shut off and the charge permitted to cool naturally without the use of cooling water. This gives a slow rate of cooling with consequent formation of large, rounded crystals. When the fine product is desired the evaporation is not carried so high, and the charge is run into a warm kettle, which is then immediately chilled with cold water in the jackets, inducing sudden crystallization and consequently fine crystals. On cooling down to room temperatures the crystals, in forming, will give off sufficient heat to drive off all but about 0.05 per cent of moisture. This removal of moisture is important, since its presence in the finished ammonium nitrate would cause the latter to cake to a solid mass before

use, as well as causing difficulties in the dynamite made from it.

To diminish the tendency of ammonium nitrate to absorb moisture, 1 or 2 per cent of petrolatum is added while the material is still warm and before removal from the kettle, so that there will be a coating of grease over each crystal. To lessen the tendency to "cake" during storage, 1 or 2 per cent of kieselguhr may be added at the same point of the process. Before removal from the kettle 1 per cent of chalk is added as an antacid, but it should not be added until the charge has cooled down to about 120 deg. F., since otherwise a reaction will take place driving off ammonia gas with consequent low yields.

The finished product is stored in barrels lined with waxed paper, or in canvas bags, in a heated storeroom. Heat is necessary to prevent absorption of moisture by the deliquescent material. From this storehouse it is taken to the dope house of the dynamite line, where it is mixed with other ingredients, screened and incorporated with nitroglycerine to form "ammonia dynamites."

The above description does not cover the so-called "direct neutralization," a process which eliminates the use of the ammonia still. If sufficiently pure ammonia liquor is available there is no necessity for distilling, and the ammonia liquor can be run directly into the neutralizing tub. The process of evaporation remains the same as described above and the relative merits of the two methods have already been discussed.

Use of Ammonium Nitrate in Explosives

In recent years conditions abroad, especially as regards financial exchange, have become such that synthetic ammonium nitrate can compete with the same compound manufactured as described above. Synthetic ammonium nitrate is received in this country from Europe and is treated to prepare it for use in commercial high explosives as described in the first part of this article. Very recently a small amount of some material has been added to the synthetic ammonium nitrate when made which prevents solidification during storage and shipment, so that it can be readily dumped out of the cask when received. In this case it is only necessary to agitate in a warm crystallizing kettle to remove the moisture and wear down the crystals to obtain a fine product ready for use in explosives.

Not only does the use of ammonium nitrate effect a very considerable saving in the cost of the explosive but it renders such an explosive much more suitable for many operations by reducing the velocity of detonation to a marked degree, reducing thus the shattering and increasing the "heaving" effect, performing more useful work per pound of explosive used than would be the case without the ammonium nitrate present.

While under ordinary conditions ammonium nitrate cannot be detonated, in combination with nitroglycerine or other similar high explosive it actually does detonate, and with a strength apparently equivalent to about seven-tenths the strength of nitroglycerine. Many of the permissible explosives used in enormous quantities in coal mines contain as much as 80 per cent of ammonium nitrate because of the fact that the latter reduces the amount of flash produced on explosion and therefore reduces the tendency of the gas and coal dust to fire and ignite the mine.

Wilmington, Del.

Commercial Preparation and Use of Fullers Earth

By T. Poole Maynard and L. E. Mallory
Geological and Industrial Engineers

FULLERS EARTH can be defined as a highly siliceous clay, usually indurated, which has the property of adsorbing certain organic coloring matters from vegetable and mineral oils. This property, which defines the earth and is indicative of its value, can be determined only by actually filtering the oil in the laboratory.

The American earths have been found more desirable for the refining of petroleum, while the English earth has been regarded as better adapted for the bleaching of edible oils. American earths have been found of distinctly superior bleaching power to English earth with the vegetable oils as well, but they have failed to displace the English earth on account of the dependable uniformity of the imported earth, thus assuring the refiner a standard of bleach, uniform filtering and reliably low oil retention properties.

Very little has been published regarding the treatment and preparation of the English earth, but it has recently been determined by the writers that certain of the American earths can be commercially prepared, so that the bleaching properties, filtering and oil adsorption are equally as dependable and these qualities found more desirable than those of the English earth.

Occurrence, Origin and Physical Character

Fullers earth is found in this country in seventeen states, but has been developed only in Florida, Georgia, Arkansas, Texas, California, Alabama and Massachusetts. Florida leads in production, with Georgia second. The Florida earth is used largely in the refining of mineral oils on account of the high specific volume of the earth.

Recent investigation by the authors has revealed extensive commercial deposits of superior bleach to any other known earths.

Fullers earth deposits are found in the more recent geologic formations, being Post-Paleozoic. The deposits represent originally calcareous clays of marine origin which have since their deposition been elevated into land areas and subjected to compression, alteration and erosion. The consolidation of the deposits under pressure and the leaching out of the lime has been followed by secondary enrichment of the silica, largely as colloidal silica and colloidal aluminum silicates.

Fullers earth is characterized by its light weight, due to the proportion and nature of the pore space. Sand in varying amounts is usually present as well as some mica and in places calcium carbonate in the form of fragments of shells. The earth is conchoidal in fracture, usually indurated and does not slake in water. It is brittle and not plastic until ground. The earth varies in color from gray to blue, and brown to greenish and yellow. The yellow earth has passed through extreme processes of oxidation and in some areas the yellow oxidized earth proves to be of superior bleach.

Although fullers earth has a true specific gravity about equal to that of other clays, it is so porous in nature that when thoroughly dry most samples will float in water, showing the presence of more than 50 per cent voids.

Chemical analyses have never been regarded as of any particular value in arriving at an interpretation of the possible value of the earth for commercial use. An ultimate analysis, beyond showing the quantity of possibly objectionable impurities as lime and pyrite, is without much meaning. A determination of hydrous silica and of the aluminum silicates, which would in effect constitute the colloidal content, often may be of direct value.

The total silica in different earths may vary from less than 50 per cent to even more than 80 per cent; the alumina is always low, usually from 5 to 20 per cent; the combined water, from 5 to 12 per cent, is about that of the more siliceous clays. These are the more important constituents and any others may be considered as adulterants, sometimes harmful. Lime and magnesia are nearly always present and the iron content is usually evidence of secondary enrichment. The alkalis in many of the commercial earths do not total more than 1 per cent. The mechanically carried water (moisture) is high, even more so than in most clays, and there is the same tendency to absorb moisture in storage.

Bleaching Power

The bleaching power of fullers earth is the basis of its commercial use. Several theories have been put forward to explain this action. Like many other colloid pecularities, it is due to a combination of mechanical and electrical properties, with chemical action eliminated from consideration only by nice differentiation. It is a combination of adsorption and mechanical filtration, accompanied by some chemical disintegration due to selective adsorption.

The active constituents of the earth are probably hydrous silica and hydrous aluminum silicates. The porous nature of the earth, due to the fact that it is built up of grains approaching colloidal size, offers a large active surface.

The driving off of the combined water does not directly affect the bleaching properties of the earth, but this may require temperatures that will destroy a portion of this power by a reduction in surface as the clinkering stage is reached. Coarsely ground earths used in the bleaching of petroleum oils are not affected in their bleaching properties when the water of combination is driven off, while the very finely divided earths used in the bleaching of vegetable oils have their bleach more materially injured by driving off the combined water.

Use in Petroleum Oil Bleaching

A few earths can be used for bleaching both mineral and vegetable oils, while most of the earths are by nature limited to one field or the other. In the bleaching of mineral oils an earth of high specific volume is more in demand, while in the refining of vegetable oils earths of lower specific volume are more desirable.

The methods of preparation of earth for the bleaching of mineral oils and vegetable oils are quite different. The preparation of the earth for the bleaching of mineral oils is much nearer standardization.

The earth is graded for bleaching mineral oils according to the nature of the oil to be treated. The more common gradings are 30 to 60 and 60 to 80 mesh, while there is some demand for 15 to 30 and minus 80 mesh. The earth is burned at a low heat to remove moisture and combined water and then placed in large cylindrical containers. The oil is percolated through under pressure, if necessary. When the oil runs too dark, the earth is washed as free of oil as practicable and burned in rotary kilns. The number of times an earth may be re-used depends mostly upon the resistance that it shows to breaking down in burning and handling; with 25 to 30 per cent loss the earth is re-used as much as ten times. The quantity of oil bleached by a ton of earth of course varies widely; with medium oils a total of 250 bbl. per ton of earth is good practice.

Bleaching Vegetable Oils

In the refining of vegetable oils, the crude oil is heated and treated with an alkali to remove the fatty acids and convert the coloring matter to the basic form. The oil is usually bleached at approaching the boiling point of water by stirring in from 1 to 5 per cent of the earth. Moisture, either in the earth or in the oil, interferes with the process. The hot oil, with the fullers earth in suspension, is then forced through a filter press. Following this, the oil is put through a deodorizing process. The refining then varies depending on the use to which the oil is to be put and upon the particular process of manufacture. Some processes include a second bleaching with a mixture of fullers earth and carbon black. The oil usually starts the bleach with slightly alkaline reaction and finishes the process somewhat acid.

The amount of earth used, from 1 to 5 per cent, is determined by laboratory control for the bleach required. The filter cake is usually washed with steam, hot water, air or various combinations of these. The cake is then wasted with any retained oil. As the earth tends to oxidize the oil, the cake must regularly and carefully be disposed of. Some earths cannot be used, as they oxidize the oil so rapidly that it takes fire in the presses.

The earth is prepared by drying and grinding 70 to 100 per cent through 200 mesh for the vegetable oil bleach. This fineness of grinding depends or should depend upon the producer's understanding of the individual characteristics of his earth. A finely porous earth requires less grinding to develop the necessary bleaching surface. The grinding is further limited by the behavior of the earth in the bleaching kettles, in the pumps and in the filter presses. Furthermore, each earth possesses a natural limit in bleach beyond which it requires much more than a relative increase in bleaching surface, whether by finer grinding or an increased percentage of earth, to obtain another point or two in bleach. A little calculation makes this understandable. One pound of commercial fullers earth offers a bleaching surface of several hundred square feet. Six per cent of this earth thoroughly stirred through the oil gives an oil film thin enough to compare closely with recently determined films of lubricating oils. The effectiveness of the earth at this concentration should be rapidly approaching a limit.

Losses of Material During Use

Fullers earth found its first commercial use in removing oil from woolen cloth. This property of absorbing oil is inherent in the earth.

In the refining of vegetable oils in 1921 nearly $2,000,000 worth of cottonseed oil was thrown on the waste dumps in filter cake. These oil losses run from 15 per cent of the weight of the earth used to more

than 30 per cent. At the lower figure they exceed in cost the value of the fullers earth. The refiner endeavors to reduce the losses of oil by scouring the cake and experimenting to find commercial means of recovery. The producer can bring his brand of earth into favor by lowering the oil losses with his earth as much as is practicable.

These losses may be divided into three more or less determinate parts.

1. Loss in oil film.
2. Loss by absorption in the pores of the earth.
3. Loss in small and inaccessible voids between the particles.

In a well-washed cake the loss in oil film should not amount to more than 10 per cent of the total loss; the loss by absorption of pores in the earth is a property of the individual earth, though it can often be lessened by proper grinding; the third and often largest factor can be regulated more directly, although a separate problem for each type of earth. The use of the best-adapted system of grinding or the proper combination of two or more systems of grinding makes possible the grading of particles that will reduce these inaccessible voids in the cake to a minimum, while in no way interfering with the filtering properties of the earth.

The authors have recently put through a wide series of commercial tests on certain earths with oil losses markedly lower than with other earths and with bleaching properties superior to those of the standard English earth.

Extent of Market and Possible Developments

The consumption of fullers earth in this country has had a very rapid growth during the past 6 or 7 years and now amounts to more than 150,000 tons annually, of which less than one-fifth is imported. While there are extensive deposits of earth, particularly in the Southern States, and some comparatively large developments have been made, the demands of industry have kept in advance and have resulted in a steady increase in price. Under this stimulus production will grow until it will be another incident in "the survival of the fittest" with the superior earths or superior processes controlling the market.

There is a possibility of a widening market in making cheap "clay pigments" due to the property of fullers earth of strongly adsorbing basic dyes. The property of adsorbing bases gives it a real value as a commercial and simple water "softener." The earth when freed of sand and properly ground is in good standing as a filler, particularly in the rubber trade. The "fines" now wasted in the preparation of the earths for the mineral oil trades may be utilized, by further preparation, for the uses above mentioned.

Carbon blacks, calcined bauxite, prepared lignite and infusorial earth are also used in the refining of oils and sirups. It is possible that fullers earth under modifications of present processes, where necessary and practical, may replace some of these materials.

Summary

Fullers earths are widely distributed in this country, particularly in the Southern States.

In arriving at the possible value of an undeveloped earth a geological interpretation of its origin is of primary importance. Determination by chemical analysis of hydrous silica and aluminum silicates may have scientific value in predicting bleaching quality.

A relative determination of bleaching surface due to porosity may be made by comparing the bleaching power of an earth at different finenesses. This may be used as a base to determine nature of grinding required not only to develop bleach but also to control oil absorption.

Commercially feasible developments are dependant on location with respect to transportation; inherent superior qualities of the earth; preparation that develops these natural advantages for a particular market, and then technical control of the product. Only by a combination of these essentials can a reliable, uniform, dependable, superior commercial earth be prepared.

Our investigations show that while American earths of superior bleach to standard English earth are on the market, yet the excessive oil retention of these earths resulting from a lack of proper grinding and technical control have prevented them from occupying the position they should have.

Earths of dependable uniformity are available and eminently satisfactory to the mineral oil refineries. However, the large amount of "fines" resulting from grinding and which cannot be used by this trade and which materials are now largely wasted can be utilized and established in other trades by their proper preparation, at values equal to the earth shipped to the oil refineries. The present losses are wasteful and inexcusable.

While the markets and the value of fullers earth have been growing rapidly, the producer for the mineral oil on the one hand has paid little attention to his byproduct in the way of "fines" and the producer of the vegetable oil bleach on the other hand has not developed the all-around desirable earth that his market demands.

With the growing knowledge of the needs of the industries, technical control of production is the next step in development and will lead to markets otherwise beyond attainment or even conception.

Atlanta, Ga.

Recent Hydro-Electric Development in Canada

The Canadian Department of the Interior has been analyzing the waterpower resources of the dominion for the past two years.

Last year was one of substantial progress, there having been brought into operation new installation to the extent of 300,000 hp. The installed waterwheel capacity now totals to 2,763,000 hp.

The 2,763,000 hp. thus far installed throughout the dominion is apportioned to the following uses: 2,013,000 hp. in central electric stations for general distribution purposes, such as operation of street railways, operation of mines, operation of electrochemical and electrometallurgical industries, operation of pulp and paper mills and for general industrial and domestic uses; 476,000 hp. installed in pulp and paper mills. In addition there is used in the pulp and paper industry 161,000 hp., purchased from the central electric stations installation; 274,000 hp. installed in industries other than central electric stations and pulp and paper mills. The total installation for the dominion averages 315 hp. per thousand of population, a figure which places Canada second only to Norway in the per capita utilization of water power among the countries of the world.

Selective Case-Carburizing

A Review of the Various Methods of Producing Local Cases—In General, Electrodeposited Copper Has Furnished the Best Protection—A Non-Metallic Coating Whose Application and Removal Present No Great Difficulties Is Described

By W. P. WOOD* and O. W. McMULLAN

ON A GREAT many occasions it is desirable to obtain surfaces of varying hardness upon the same piece of steel. A camshaft is a good example of this, inasmuch as it is desirable to have the surface of the cams hard and resistant and the intervening bearings, etc., much less hard. This object is usually accomplished by case-hardening the surfaces of the cams, leaving the bearings without the carburization. Such a procedure may be termed selective case-carburizing.

Selective case-carburization is due to:

1. Desire to leave some parts soft for riveting or fixing purposes.
2. Desire to leave parts soft that are to be subsequently machined, and which are adjacent to case-carburized parts.
3. Desire to produce hard wearing surfaces alternating with softer surfaces.
4. Desire to maintain the interior of tapped holes in a soft condition.
5. Desire to leave axle shafts or spindles soft in the middle so as to straighten or set them after hardening.
6. Desire to maintain threads true and soft. As a rule, when a threaded part is case-hardened, it becomes warped and thrown out of center with the ground surface of the rest of the piece.

The advent of the motor car industry has brought about great changes in the old methods of case-carburizing and it is in this industry where the desire to obtain localization of case-carburizing is most frequent. This of course means that there was but little occasion for securing selective case-carburizing until the last few years. If much experimental work has been done, it has not been published, for very little is to be found in the literature concerning it, and apparently no résumé of the entire subject has been heretofore attempted.

The requirements for the production of localized cases are essentially simple. It is well known that carburization is brought about through a cycle of reactions in which carbon monoxide acts as the carbon carrier. In order then that no case be formed, it is only necessary to produce a coating upon the surface of the steel which is impervious to carbon monoxide. The difficulty arises in producing a coating which is unaffected by the high temperature of carburization and one which is reasonably easy to remove.

Classification of Methods

Methods may be divided into a few general classes according to the nature of the "resist" used in obtaining the desired soft spots:

I. Metallic coatings.
   1. Thin plate of copper produced by dipping in or rubbing with $CuSO_4$ or $CuCl_2$.
   2. Thin plate of copper produced by electrolysis.
   3. Thin plate of nickel produced by electrolysis.
   4. Thin plate of tin produced by electrolysis.
   5. Coatings of metals produced by Schoop spray process.
   6. Coating of steel, produced by shrinking on a thin steel sleeve.

II. Non-metallic coatings.
   1. Clay, loam, asbestos wrappings.
   2. Fire paints enamel.
   3. Mixtures of clays and other inert substances.
   4. Mixtures of sodium silicate with clays, calcium hydrate, sand, and others.
   5. Putty.

III. Leaving parts oversize, and grinding off case.

IV. Packing pieces in contact at desired soft surfaces.

Metallic Coatings

A thin copper plate produced by dipping or rubbing with $CuSO_4$ has not in general proved suitable. It was originally developed from the work of de Dion-Bouton.[1] Brearley,[2] and Guillet and Bernard[3] make rather unfavorable mention of this method.

A most generally used and successful method of producing local cases is by a copper coating deposited electrolytically from a cyanide bath. (A bath of $CuSO_4$ is recommended by some.) Probably the most extensive work upon electrolytic copper coatings has been done by Guillet and Bernard.[3,4,5] They state[3] that a thickness of 0.01 mm. is sufficient for carburization at 850 deg. C. but 0.02-0.03 mm. is required at 1,000 deg. C. There is some danger of diffusion of the copper under some circumstances,[4] but this is not of much importance. Giolitti[1] states that the use of copper coatings can be successful only below 950 deg. C.; Lothrop[6] states that a thickness of 0.0005 in. is required; Harbee[7] mentions a thickness of 0.001 in. as preventing the action of the most vigorous carburizers; Keachie[8] is of the opinion that a thickness of 0.002 in. is required, while Zimmerli[9] maintains that a thickness of only 0.0004 in. is necessary. Other writers who discuss the utility of copper coatings are Brearley,[2] Giolitti,[10] Tiemann,[11] E. F. Houghton Co.[12] Jones,[13] Gleason,[14] Paxton,[15] Grant,[16] Edwards[17] and Van Deventer.[18]

Coatings of nickel and tin have not been generally successful.[2,3,4,10,13] Guillet and Bernard[5] state that carbon monoxide will pass through any nickel coating and that tin is unsatisfactory unless on a horizontal surface where it will not run off. Paxton[15] mentions nickel plating as a satisfactory means of preventing case-carburizing.

The application of the Schoop spray process in applying coatings is discussed by Guillet and Bernard.[3,5] The apparatus is rather expensive and a thicker coating is required.

Giolitti,[1] Brearley[2] and Grant[16] describe the method

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of producing local carburization by means of a soft steel sleeve. This sleeve must be thin so that it will be brittle after the carburizing operation and may be broken off by tapping with a hammer.

Requirements of Non-Metallic Coatings

Non-metallic coatings usually include mixtures of clays, sodium silicate, sand, calcium hydrate and many other substances. Clays or sodium silicate alone are not successful, but some of the mixtures using sodium silicate as a base have been partly successful. Nearly all the writers have gone more or less at length into their use. Giolitti[1] quotes Grenet to the effect that putty is useful in preventing carburization.

A non-metallic coating should fulfill the following requirements:

1. Easily applied through painting on with a brush or as a paste.
2. Will not shrink or crack.
3. Will not melt or peel off when heated.
4. Will not become porous and permit passage of carbon monoxide at high temperatures.
5. Easily removed after carburizing treatment is finished.
6. Material and operating cost low.

Experiments on Coatings

The attempt to discover such a coating was of a rather routine nature involving intelligent selection of material and a large number of trial runs. The same carburizer was used throughout, being the so-called rapid mixture produced by the Parke Chemical Co. of Detroit.

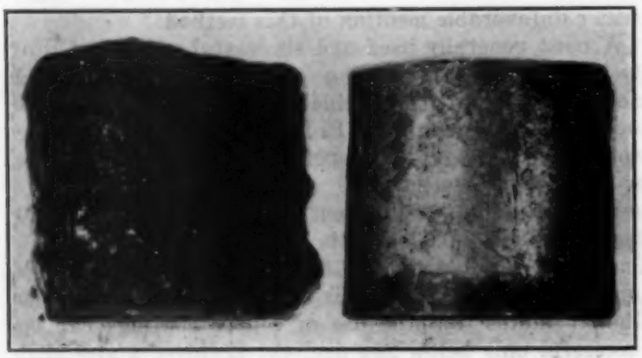

FIG. 1—SAMPLE AS REMOVED FROM FURNACE, AND AFTER DIPPING IN MOLTEN SODIUM HYDROXIDE

Samples were heated in an electric furnace, pyrometrically controlled, usually at 1,700 deg. F., which might be considered as an average case-carburizing temperature. The time ranged from 2½ to 24 hours at the above temperatures, as indicated in the table of results. Samples were of plain 0.11 carbon steel in the form of a cylinder ¾ in. diameter and about 1 in. long, coated to various depths about half way round with the mixtures. Fig. 1 shows a sample with its coating. These samples were placed in a threaded steel tube, 2 in. in diameter and 6 in. long, closed by screwing a cap on each end. Usually more than one sample was placed in the tube at a time, in which case they were separated from one another by the carburizer with which the tube was filled. The closed tube was then placed in the furnace. Fresh case-hardening compound was used for each run. Before applying the coating some of the samples were polished on a fine grinding wheel, while others were not, but this did not seem to affect the adherent or protective properties of the mixture. After removal from the furnace the samples were permitted to cool in the tubes, after which they were removed, cut, polished, etched and examined under the microscope.

Table I contains a summary of the results. Various thicknesses of the same material were tried. In making the mixtures all dry substances were finely ground and then mixed with the base, either sodium silicate or clay. Water was then added until a good smooth paste

TABLE I—SUMMARY OF CARBURIZING EXPERIMENTS

Thickness of Coating, Mm.	Coating Material	Time, Hrs.	Temp., Deg. F.	Results
0.3	Sodium silicate	3½	1,700	Protected
0.5	Sodium silicate	3½	1,700	Protected
1	Sodium silicate	3½	1,700	Protected
2	Sodium silicate	3½	1,700	Protected
2	1 Flint clay:3 sodium silicate	4	1,700	Protected in spots only
2	1 Flint clay:1 sodium silicate	4	1,700	Thin case formed
2	3 Flint clay:1 sodium silicate	4	1,700	Not much protection
1.5	Flint clay	4	1,700	Not much protection
2	1 Flint clay: 3 sodium silicate	6	1,700	Protected in spots only
0.3	MgO+sodium silicate	6	1,700	Protected
0.3	Sodium silicate	6	1,700	Protected except where coating scaled off.
0.3	Sodium silicate	6	1,700	
0.3	Sodium silicate	8	1,700	Thin case formed
0.5	Sodium silicate	8	1,700	Cased in spots
3	Portland cement + sodium silicate	8	1,700	Not much protection
1	Sodium silicate	6	1,700	Protected
2	Calcined flint clay	6	1,700	Cased
1	MgO + sodium silicate	6	1,700	Results not good
2	1 Flint clay:3 sodium silicate	6	1,700	Protected except one spot
1.5	*1 MgO:3 sodium silicate	6	1,700	Cracked. Not protected
1	1 MgO:20 sodium silicate	6	1,700	Protected, but tends to crack
2	1 calcined flint clay:1 sodium silicate	6	1,700	Gives a case
2	3 Calcined flint clay:1sodium silicate	6	1,700	Gives a case
1	1 Asbestos:5 sodium silicate	6	1,700	Mostly protected. Asbestos was too coarse
2	1 Al_2O_3:2 sodium silicate	6	1,700	Protected
0.3	1 Silex:2 sodium silicate	6	1,700	Cased. Layer too thin
1.5	A commercial selective carburizing compound	6	1,700	Cased in two or three spots
1	1 Pb_3O_4:2 sodium silicate	6	1,700	Cased in spots
0.5	1 ZnO:2 sodium silicate	6	1,700	Slightly cased. Layer too thin
1.5	1 Plastic clay:1 Al_2O_3:1 sodium silicate	6	1,700	Cased in spots
3	A commercial selective case carburizing compound	6	1,700	Thin case formed
1	1 Asbestos:3 sodium silicate	6	1,700	Good protection
1	1 Silex:2 sodium silicate	6	1,700	Cased in spots
0.2	1 Al_2O_3:2 sodium silicate	6	1,700	Cased in two small spots
1.5	1 Al_2O_3:1 plastic clay:2 sodium silicate	6	1,700	Cased in spots
2.5	1 Al_2O_3:1 sodium silicate	6	1,700	Thin case formed
2	1 ZnO:2 sodium silicate	6	1,700	Cased
2	3 Plastic clay:1 sodium silicate with outer layer of sodium silicate	6	1,700	Peeled off in furnace
1.5	1 Plastic clay:1 sodium silicate	6	1,700	Cased
0.5	1 Asbestos:3 sodium silicate	6	1,700	Good protection
1.5	1 Plastic clay:1 sodium silicate with outer layer of sodium silicate	6	1,700	No case. Sticks on
1	1 Plastic clay:2 sodium silicate	6	1,700	Cased in spots
0.3	1 Al_2O_3:3 sodium silicate	6	1,700	Cased in spots. Layer too thin
1	1 Asbestos:3 sodium silicate	6	1,760	Good protection
1	1 Kaolin:2 sodium silicate	6	1,760	Cased
0.7	1 Asbestos:2 sodium silicate	6	1,760	Protected
1.5	1 Asbestos:3 sodium silicate	8	1,825	Protected
0.5	1 Asbestos:2 sodium silicate	8	1,825	Protected
2	3 Calcined flint clay:1 sodium silicate with thin outer layer of sodium silicate	6	1,760	No case. Sticks on
1	1 Kaolin:1 sodium silicate	8	1,825	Slightly cased
1	1 Al_2O_3:3 sodium silicate	8	1,825	Protected
0.7	1 Asbestos:1 sodium silicate	6	1,700	Slightly cased
1	1 Asbestos:5 sodium silicate	6	1,700	Protected
1	2 Asbestos:1 sodium silicate	6	1,700	Slightly cased
1	1 Asbestos:10 sodium silicate	6	1,700	Protected
1	1 Asbestos:2 sodium silicate	24	1,750	Protected
1	1 Asbestos:2 sodium silicate	24	1,750	Protected
1	1 Al_2O_3:2 sodium silicate	24	1,750	Slightly cased in spots
1	1 Al_2O_3:3 sodium silicate	24	1,750	Slightly cased in spots
1	1 Kaolin:1 sodium silicate	8	1,700	Badly cased
1	1 Kaolin:3 sodium silicate	8	1,700	Cased in spots
1.5	1 Al_2O_3:3 sodium silicate	8	1,700	Protected
3	1 Asbestos:3 sodium silicate	24	1,750	Good protection
3	1 Asbestos:3 sodium silicate	24	1,750	Good protection
3	1 Al_2O_3:3 sodium silicate	24	1,750	Good protection
2	1 Na_2CO_3:3 sodium silicate	2	1,700	Cracked off when drying
2	1 Ca $(OH)_2$:3 sodium silicate			Disintegrated while drying
1.5	1 Borax:3 sodium silicate	8	1,700	Cased in spots
2	Putty	7	1,700	Cased
2	Plasteline	7	1,700	Cased

* 1 MgO:5 sodium silicate also tried but coating shrank and peeled off.

Fig. 2—Case after 8 hr. at 1,700 deg. F. in unprotected sample.

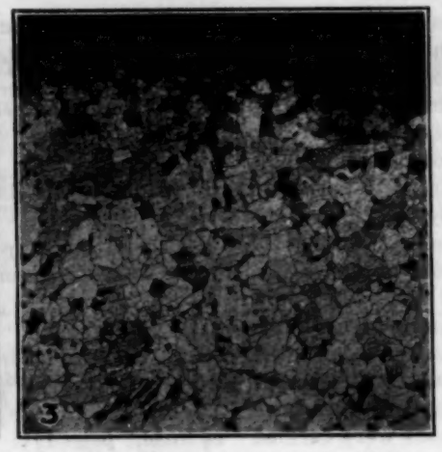

Fig. 3—Protected by 1 asbestos plus 3 sodium silicate; after 8 hr. at 1,700 deg. F.

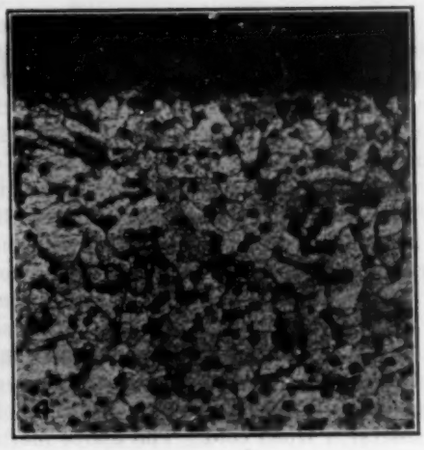

Fig. 4—Protected by 1 alumina plus 3 sodium silicate; after 24 hr. at 1,750 deg. F.

FIGS. 2 TO 4—MICROSTRUCTURE OF VARIOUS SAMPLES ETCHED WITH 5 PER CENT HNO_3

was obtained. The coatings were permitted to dry in the air until hard enough to prevent being pushed out of place when handling. Too rapid heating will leave the dried coating full of bubbles, which permit the passage of carbon-carrying gases.

First layers of various thickness of pure sodium silicate were tried. When the water solution of sodium silicate was thin enough so that it could be readily applied, surface tension forces pulled the silicate into drops, making an even coating difficult to obtain. When the solution was made thicker, it also became very viscous. Pure silicate offered good protection against carburizing except when the pieces were in the furnace for a long time, when it would scale off in small spots, there permitting carbon penetration. Ordinary clay is porous and permits the penetration of gas at high temperatures and also tends to shrink, crack and peel off.

Adulterant for Sodium Silicate or Clay

The problem at this stage was narrowed down to finding something to mix with sodium silicate to make it more rigid and prevent surface tension action, or to mix something with clay which would fill up the pores and prevent the passage of gas.

Of those substances mentioned in the literature, the following were found to be unsatisfactory if any good degree of protection is desired: Clay and its various mixtures, mixtures of kaolin and sodium silicate, putty, hydrated lime and sodium silicate, sodium carbonate and sodium silicate, sodium borate and sodium silicate.

Tests with a commercial local carburizer were made, the directions being carefully followed. All experiments showed more or less carburization. This particular method also required a good deal of time and care in mixing, applying and drying the coating. No test was made on the mixture of 50 per cent sodium silicate, 25 per cent china clay, 18¾ per cent amorphous silica and 6¼ per cent fine silver sand specified in Whyte's patent, it being considered that this mixture was unnecessarily complicated and because of the fact that no mixture was found to give perfect protection when the amount of sodium silicate was as low as 50 per cent. Copper plating produced both by dipping in copper sulphate and electroplating from a cyanide bath were tried. Dipping was found to give a porous, loosely adhering layer which did not give good protection. Electrodeposited copper plate gave good protection, as has been abundantly demonstrated by many workers.

Of those mixtures tried only two were found to be satisfactory. Finely ground asbestos and sodium silicate gave perfect protection whenever the percentage of sodium silicate was 67 or more. Aluminum oxide and sodium silicate mixtures give about equally good protection, but the coating needs to be thicker than that for the asbestos mixture. The method of preparing and applying these coatings has been mentioned previously. Different percentages of asbestos and sodium silicate were tried in order to ascertain between what limits protection was to be had. It was found that when the amount of asbestos became greater than one part in three by weight, the protection became imperfect, while the lower limit becomes one of viscosity—that is, the mixture is not plastic enough and does not stick.

Twenty-four-hour tests were made, showing that 1 mm. of the asbestos-sodium silicate mixture gives protection at 1,750 deg. F., while it requires a thicker layer of the aluminum oxide-sodium silicate mixture to give equally good protection. Tests carried out at a temperature of 1,825 deg. F. showed that these coatings also afforded good protection at this higher temperature.

Experiments made on practically carbonless ingot iron showed the protection with 1.5 mm. asbestos-sodium silicate mixture to be as complete as that with a coating of electrically deposited copper, the two samples being in the same container for 10 hours at 1,700 deg. F., and therefore under exactly the same conditions.

Removal of Protective Coating

It was found that all coatings that gave any good degree of protection adhered firmly to the piece after carburizing and if it were desired to have the surface of the carburized piece absolutely smooth and clean the coating could not be removed satisfactorily by pounding with a hammer. This was to be expected, since if the coating did not adhere firmly, it would probably permit the passage of gas between it and the steel, which would result in carburization. An attempt was made to put on first a layer of material such as clay (which would come off readily after carburizing) and after permitting this to dry somewhat, put on a second layer which would be impervious to the carburizing gases. Where the inner coating was such that it would come off readily, the compound coat was also liable to crack and peel off. The process also took much longer because of the extra coat, so was not very satisfactory when viewed from any angle.

The best method for removing asbestos- or alumina-sodium silicate coatings is to dip in molten sodium hydroxide. A sample which had one etched surface before being immersed still showed the crystal grains under the microscope, showing the sodium hydroxide to have practically no corrosive action on the steel. Fig. 1 shows two samples, one with a coating and one from which the coating has been removed by this means.

Another method is to quench the piece in water. If one quenching does not remove the coating completely, it can be given a second quench, or the small remaining portion can be quickly dissolved off in sodium hydroxide. Heating in molten calcium chloride so softens and disintegrates the coating that it can be removed by quenching once in water directly from the bath or by mere immersion when cold. The above methods were carried out with the coatings of alumina-sodium silicate and asbestos-sodium silicate mixtures.

Preventing Decarburization

The effectiveness of the mixtures in preventing decarburization of high-carbon steel and white cast iron was tested. The first samples were placed in the electric furnace without any material surrounding them. Under these conditions the coating tends to soften and run to a certain extent, making it rather thin in places. Thinking that some surrounding material would prevent this, samples were placed in one of the tubes mentioned above, used in carburizing, and packed in gravel so that the conditions would approach those of the samples when carburizing. Even under these circumstances the coatings fused to a certain extent and decarburization was again not entirely prevented.

Summary and Conclusions

1. A review of the literature establishes the fact that an electrolytically deposited plate of copper furnishes the most satisfactory metallic coating to produce localized case-carburizing. Under many circumstances and conditions this method is the most satisfactory one to use.

2. Non-metallic coatings have not heretofore proved generally successful under all conditions and experimental work with various mixtures which have been recommended in the literature has shown that they are not uniformly successful.

3. A non-metallic coating consisting of definite mixtures of sodium silicate with either finely ground asbestos or alumina furnishes good protection from carburizing conditions. It is easily painted on the metal and may be removed by immersion in molten sodium hydroxide or by quenchings in water. Calcium chloride in the molten state is also useful in loosening these coatings.

It is not felt that these coatings have universal application, but it is believed that there may be many times when their use may not only be possible but also profitable in heat-treating shops.

4. The coatings mentioned above are not as efficient in preventing decarburization as they are in preventing carburization.

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Ann Arbor, Mich.

Legal Notes

By Wellington Gustin

Damages Awarded Where Injunction Against Discharge of Waste Was Denied to Aid War

In the case of E. G. Temple vs. E. I. du Pont de Nemours & Co. the complainant brought suit to restrain the defendant company from discharging its waste material into Bailey's Creek, which ran along his premises for about a mile, situated in Prince George County, Virginia. In 1915 the company established on the opposite side of the creek from complainant's lands a guncotton plant which employed at times as many as 25,000 men and used daily about 90,000,000 gal. of water.

The waste products of this operation, consisting in part of refuse cotton and other substances impregnated with poisonous chemicals, were carried into the creek, and it was claimed the navigability of the stream was greatly impaired and its waters polluted. Complainant sought to enjoin the du Pont company against discharging its waste material into the stream and to require it to clean out the creek and restore the waters to their natural state.

After the suit was begun war with Germany was declared and while the United States District Court at Richmond, Va., held the suit was properly instituted, it refused an injunction in view of the probable consequences of closing down the plant in face of the war and considering the public interest involved. Instead of the restraining orders demanded by the plaintiff, the court awarded damages to complainant in the sum of $8,500, and this decision was later upheld and affirmed by the United States Circuit Court of Appeals. (272 Federal, 456.)

Froth Flotation Tests on Bituminous Coking Coal

A Study of the Applicability of Froth Flotation to the Treatment of Fine Sizes of Bituminous Coal From Wilkeson, Wash., Including Various Experimental Arrangements of Roughing and Cleaning Operations for Best Ash Removal

BY OLIVER C. RALSTON* AND GAICHI YAMADA†

THIS research is the second undertaken in connection with a study of the applicability of froth flotation to the treatment of the fine sizes of coals of the Pacific Northwest. It forms a part of the coal-washing program of the Northwest Experiment Station of the Bureau of Mines in co-operation with the University of Washington, at Seattle. The first paper, by A. P. Wichmann and Oliver C. Ralston,[1] reviewed the past work on the flotation of coal and reported a number of experiments made to test the applicability of the process to the coals of the Pacific Northwest.

This paper reports the results of tests made to ascertain why the tests in the first research gave such poor results when finely ground coal was treated. It is naturally to be expected that fine grinding should better liberate the ash from the pure coal substance, yet flotation of the finely ground coal gave "dirtier" concentrate than flotation of relatively coarse coal.

The experiments consisted of a series of sink-and-float tests on the raw coal to ascertain the fineness of crushing necessary to liberate the maximum amount of ash and to provide a standard of permissible ash in the coal concentrate to be made by flotation; a series of tests on flotation of coal ground very fine under water in a pebble mill to test a number of oils and to determine the efficiency of flotation in removing the ash of this coal under the most extreme conditions; a series of tests on dry-crushed coal to compare with the wet-crushed material and also to determine the effect of size of crushing; and, finally, a number of tests operating on a definite flow sheet with roughing and cleaning operations in various combinations to see if a clean finished product would be made.

The sample of coal used for these tests came from, the No. 3 bed of the Wilkeson mine at Wilkeson, Wash. It consisted of the material passing a ¾-in. screen in a large screen test of the raw coal from this mine. The coal of this mine is normally crushed and washed before passing to beehive coke ovens.

SINK-AND-FLOAT TESTS

A 20-kg. sample was crushed in rolls, removing oversize with a 35-mesh screen and returning to the rolls, and recrushing till all the sample passed through the screen. One kilogram of this material was used for a screen test (Tyler Ro-Tap) and each of the sizes was treated by the sink-and-float test commonly used in connection with coal washing, using a solution of zinc chloride of 1.34 sp.gr. to float the clean coal and allow the ash to sink. Previous work on coarser sizes of this coal had shown that the coal was somewhat "bony" and the cleanest particles contained about 7 to 9 per cent ash. Had the coal been cleaner, a zinc chloride solution of 1.30 sp.gr. would have been used.

Ten grams of each size of coal was placed in a 200-c.c. capacity separatory funnel and about 100 c.c. of zinc chloride solution of 1.34 sp.gr. was poured into the funnel. After 1 minute of shaking in order to mix and wet the sample the funnel was allowed to stand 12 hours in order to permit the heavier particles to sink to the bottom and the lighter materials to rise to the surface. Manipulation of the stop-cock then permitted separate collection of the sink product and of the float product. These were thoroughly washed with slightly acidulated wash water until no trace of zinc was found in the filtrate. The sample was then dried in an electric oven at 70 deg. C., weighed and analyzed. The screen analysis and the sink-and-float tests on this material are shown in Tables I and II, all figures being calculated on a moisture-free basis. The assumption was made that the material consisted of pure coal, ash and moisture. The latter two were determined and the pure coal was then calculated by difference.

TABLE I—SCREEN ANALYSIS OF WILKESON BED NO. 3 COAL, CALCULATED ON MOISTURE-FREE BASIS

Size—Meshes Per In.	Average Diameter, Mm.	Weight, Per Cent	Ash, Per Cent
Original—35	..	100.00	23.35
On 48	0.356	19.9	24.95
On 65	0.252	20.1	24.74
On 80	0.184	10.3	23.63
On 100	0.153	11.1	23.37
On 150	0.126	4.7	23.52
On 200	0.087	22.2	23.05
Through 200	0.074	10.7	23.48

TABLE II—SINK AND FLOAT TESTS, MOISTURE-FREE BASIS

	Float in $ZnCl_2$ Solution, Sp. Gr. 1.34			Sink in $ZnCl_2$ Solution		
Size, Mesh	Weight, Per Cent	Ash, Per Cent	Recovery Per Cent	Weight, Per Cent	Ash, Per Cent	Elimination of Ash, Per Cent
On 48	56.86	9.41	69.16	43.14	46.65	78.9
On 65	60.49	12.43	71.85	39.51	47.40	74.2
On 80	62.65	10.11	72.87	37.35	39.90	72.1
On 100	59.75	8.69	70.38	40.25	42.98	76.9
On 150	61.37	9.66	71.68	38.63	43.20	73.8
On 200	56.12	9.90	64.65	43.88	37.08	74.6
Through 200	49.30	16.12	52.95	50.70	27.52	63.7
On 200	64.18	12.25	62.50	35.82	40.86	65.01
Through 200	63.20	17.84	66.25	36.80	28.09	47.85

From Tables I and II the following conclusions can be drawn: The ash is about equally distributed in all the sizes of the coal, indicating that fine grinding, at least to 200 mesh, liberates little or no more ash than grinding to pass a 35-mesh screen; the cleanest coal contains about 8.69 per cent ash and on an average it is mechanically feasible to obtain 70 per cent of the combustible matter in the form of a 9 to 10 per cent ash product.

High inherent ash is characteristic of the coals of the Pacific Northwest, particularly the lower grade ones. Just why the more lignitic coals should have higher ash

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[1]Oliver C. Ralston and Arthur P. Wichmann, "The Froth Flotation of Coal," CHEM. & MET. ENG., vol. 26, No. 11, March 15, 1922, p. 500.

than the anthracitic ones, even in the same field where part of the field has been altered into anthracite by local metamorphism, is not easy to understand. The true lignites of Nevada, California and Oregon are all very high in ash, so that they have frequently been considered of no value whatever and have been more or less neglected and are consequently not well charted nor described in the literature. The inherent ash in these coals is quite evidently too finely disseminated to be liberated by any ordinary commercial type of grinding. This has been revealed by both the sink-and-float tests we have carried out and by the froth flotation tests reported later in this paper.

Tests Under Reduced Pressure

The ash content of the float fractions of the material which passes a 200-mesh screen in the tests reported in Table II shows that the ordinary sink-and-float test is not adapted to the treatment of these fine sizes. Evidently the fine dust is buoyed up so that it floats, or else it is entrained in floccules of clean coal. To test the hypothesis that possibly the fine coal was full of gas bubbles which gave it too low an apparent specific gravity, two tests were carried out by applying reduced pressure to the surface of the zinc chloride solution in which the finely ground coal was suspended. A similar test with zinc chloride solution of lower specific gravity than those shown in the table had given no float, so we found it necessary to use denser solutions. The data on these tests are given in Table III.

TABLE III—SINK-AND-FLOAT TESTS UNDER REDUCED PRESSURE ON DRY GROUND COAL (-200 MESH) SOAKED IN $ZnCl_2$ SOLUTION FOR 2 HOURS UNDER REDUCED PRESSURE

		Float			Sink	
Sp. Gr. of $ZnCl_2$	Pressure, Atm.	Weight, Per Cent	Ash, Per Cent	Recovery, Per Cent	Weight, Per Cent	Ash, Per Cent
1.37	0.1	7.7	10.48	8.90	92.3	23.77
1.48	0.1	87.8	16.98	93.20	12.5	55.80

While these tests failed to give us clean float products, they are quite interesting in that treating the coal under a reduced pressure evidently removed gases from the pores of the coal, so that its apparent specific gravity was increased. However, to assure ourselves, since the above tests had been run with dry-ground coal, we prepared a sample by wet grinding in a pebble mill, grinding till it all passed a 200-mesh sieve. This material was then subjected to sink-and-float tests in zinc chloride solutions of varying specific gravities, the data of which are given in Table IV.

TABLE IV—SINK-AND-FLOAT TESTS ON WET GROUND MATERIAL (-200 MESH)

		Float		Sink	
Sp. Gr. of $ZnCl_2$ Soln.	Pressure, Atm.	Weight, Per Cent	Ash, Per Cent	Weight, Per Cent	Ash, Per Cent
1.61	1.0	98.9	22.68	1.1	....
1.56	1.0	98.7	22.93	1.3	....
1.52	1.0	98.8	22.34	1.2	....
1.45	1.0	99.1	21.48	0.9	....
1.40	1.0	0.1	....	99.9	....
1.34	1.0	0.0	....	100.0	....
1.45	0.1	84.7	19.87	15.3	31.27

Under full atmospheric pressure this coal tended to all float or all sink, according to the specific gravity of the $ZnCl_2$ solution, and had an apparent specific gravity between 1.40 and 1.45. On treating a sample with 1.45 sp.gr. solution at one-tenth atmospheric pressure, in order if possible to remove the gas bubbles from some of the ash material and permit it to sink, there was a separation of high-ash material and the float coal was cleaner, but the separation was not clean.

We are not reporting all the various sink-and-float tests made by us, but the above illustrates the fact that this method of studying the ash in the coal is not applicable to the fine sizes and hence is not available for controlling the work in a froth flotation study.

Effect of Mesh on Gravity

The anomalous results obtained in this study can be explained by the following hypothesis: Coal is a porous substance with long cells, more or less resembling compressed charcoal. The true specific gravity of amorphous carbon has been determined by various experimenters to be about 1.88 and the apparent specific gravity of clean coal, 1.30, is evidently due to the porous nature of the coal, the pores being filled with moisture and gases. With the coarse lumps of coal ordinarily dealt with in the sink-and-float tests, the greater portion of the pores is buried and cannot be filled by the zinc chloride solution, even on long soaking or even boiling. Soaking is necessary to get consistent results even with coarse coal due to the necessity of displacing all easily displaced air in pores that are open to the outside. Boiling temperatures during soaking also assist in getting the samples properly saturated with solution. When fine sizes of coal are treated by the sink-and-float test, a much greater proportion of the pores is open to the outside and hence, by applying reduced pressure during the application of the test, it is possible to displace a greater proportion of the gases from the pores and substitute zinc chloride solution in these pores. This results in an increased apparent specific gravity. In the case of the Wilkeson coal the increase was from 1.34 for coal in lumps coarser than 100 mesh to approximately 1.43 when it was reground to pass a 200-mesh screen.

Froth Flotation Tests of Slimed Coal

Due to uncertainty of previous work on slimed coal we felt it best to repeat some of the work, particularly a series of tests with different types of flotation oils, to see if we could find one that had more marked selective properties. Not a great deal of true slime is formed in breaking the coal for coal washing, but that which is formed is thrown away. We therefore decided that if suitable conditions could be found for flotation of clean coal the work would be justified.

The sample tested was ground very fine in a porcelain pebble mill to pass a 200-mesh screen. It was stored in a tub under water and for each test the pulp was stirred up and approximately the same volume dipped into the flotation test machine.

The machine used was the Ruth junior laboratory machine. It was run at a constant speed of 1,200 r.p.m. and the aëration varied by restricting the air that went down the hollow spindle. Seattle city water was used in all tests. This water is very pure, being frequently used in place of distilled water for filling storage batteries. The pulp dilution was varied from 1:9 to 1:15. When flotation oil was added, the opening in the spindle was closed to prevent formation of a froth until the oil had been well stirred into the pulp. Tests were carried out slowly, adding a small quantity of oil at a time, as it was thought previous work had suffered from overoiling of the pulp. The concentrate was removed in three portions to ascertain if there was any variation in the flotability of different constituents of

TABLE V—SUMMARY OF FLOTATION TESTS ON COAL SLIME, CALCULATED ON MOISTURE-FREE BASIS

Sample: Wet ground coal in pebble mill under 200 mesh
Assay of the sample: 23.35 per cent ash
Machine: Ruth laboratory flotation machine, junior
Speed: 1,200 r.p.m.
Water used: 3,500 c.c. at room temperature, 15 to 22 deg. C.
Duration: 1st concentration, 30 min.; 2nd conc., 30 to 15 min.; 3rd conc., 15 to 10 min.

		1st Concentrate				2nd Concentrate					3rd. Concentrate					Tailing		
Test No.	Kind of Oil Used	Weight, Per Cent	Ash, Per Cent	Oil Lb. Per Ton	Recovery, Per Cent of Pure Coal	Weight, Per Cent	Ash, Per Cent	Cumulative Amount of Oil, Lb. Per Ton	Cumulative Recovery, Pure Coal	Average Per Cent Ash	Weight, Per Cent	Ash, Per Cent	Cumulative Amount of Oil, Lb. Per Ton	Cumulative Recovery of Pure Coal	Average Per Cent Ash	Weight, Per Cent	Ash, Per Cent	Elimination of Ash, Per Cent
1	Pine oil	26.26	14.53	0.17	30.6	37.26	13.59	0.34	74.5	13.74	24.70	34.15	0.51	96.7	19.46	11.78	78.70	35.5
2	8 pt. kerosene, 2 pt. pine oil	29.66	12.67	0.27	32.4	35.50	12.82	0.38	71.9	12.77	26.65	27.92	0.65	97.9	17.16	8.19	80.60	29.6
3	X-cake-xylidine	29.80	11.15	0.36	32.6	50.00	11.79	0.79	86.7	11.57	11.80	24.50	1.11	97.7	13.22	8.40	76.70	34.8
4	Coal-tar creosote	59.40	13.50	0.21	67.0	.....	.....	.....	.....	.....	29.20	24.62	0.42	95.8	17.17	11.40	71.60	34.9
5	Carbolic creosote	34.80	13.94	0.09	39.1	25.98	13.87	0.34	68.3	13.92	28.22	23.63	0.60	96.4	17.00	11.00	74.60	35.2
6	Phenol 5 per cent aq. sol.	37.35	13.92	0.17	41.8	17.45	14.46	0.84	61.3	14.08	.....	.....	.....	.....	.....	45.00	34.25	66.7
7	Cresylic acid	35.30	14.55	0.08	39.3	41.11	14.05	0.33	85.3	14.27	14.31	34.20	0.58	97.5	17.42	9.28	79.10	31.8
8	Crude wood turpentine	18.48	11.68	0.13	20.9	36.22	11.26	0.38	62.7	11.41	34.42	22.70	0.77	96.8	15.75	10.87	76.90	38.2
9	1 pt. xylidine, 4 pt. Calol D4	17.52	11.87	0.13	19.7	28.45	11.28	0.39	51.9	11.52	37.60	16.98	0.64	91.8	13.75	16.43	60.70	46.1
10	1 pt. pine oil, 4 pt. Calol D4	18.21	11.43	0.16	20.4	44.90	11.80	0.47	70.6	11.68	29.33	26.40	0.78	97.9	16.37	7.56	78.20	28.1
11	4 pt. pine tar oil, 1 pt. kerosene	30.57	13.58	0.28	34.2	.....	.....	....	....	.....	55.49	16.73	0.96	94.1	15.59	13.94	67.40	41.2
12	1 pt. gas-house tar, 4 pt. pine oil	15.28	13.90	0.11	17.2	23.58	12.57	0.21	44.2	13.08	50.42	20.60	0.42	96.7	17.32	10.72	76.30	34.6
13	4 pt. gas-house tar, 1 pt. pine oil	35.55	12.57	0.14	40.8	39.30	15.05	0.28	84.5	13.88	15.09	35.75	0.43	97.2	17.52	10.06	79.50	33.7
14	Hardwood creosote	17.47	16.28	0.24	19.4	18.59	13.67	0.48	40.8	14.93	53.52	20.32	1.08	97.5	18.33	10.42	81.30	34.2
15	Kerosene	11.52	15.53	0.47	12.7	23.04	14.28	0.93	38.4	14.55	51.60	17.08	1.07	94.1	16.75	13.84	67.50	40.3
16	4 pt. gas-house tar, 1 pt. pine oil	26.44	18.80	0.28	28.0	45.75	16.42	0.40	77.9	17.29	19.18	23.81	0.46	96.9	18.67	8.63	72.90	27.0
17	Ditto	41.45	16.37	0.23	46.9	32.99	25.10	0.35	80.2	20.24	14.31	20.78	0.46	95.6	20.30	11.25	71.00	30.7

the coal. The last concentrate was taken off 30 minutes to 1 hour after beginning the test, and flotation was continued till no more froth would form. The residual pulp in the machine was of a chocolate color and analysis showed that it was usually nearly all ash.

The data on these tests are contained in Table V.

In this table are given the amount of oil used in making each concentrate, the percentage of ash in the concentrate and the recovery of pure coal or combustible matter. In the columns dealing with the second concentrate are also given the cumulative recovery of combustible (concentrates Nos. 1 and 2 together) and the average percentage of ash in the first two concentrates. Similar figures are given for the third concentrate.

Appearance of the Froth

The first froth was of a brown color, while the last one was very black. We expected that the brown froth would contain a high percentage of ash, but found that it was the cleanest. The brown color was evidently due to greater subdivision of the coal. Since screen analyses could not be made on this very fine material, we had to be content with microscopic examination. We were able to see qualitatively that the first froth contained much very fine ground coal and the last froth was the coarsest coal. This might have been expected, as it is well known that the finer sizes of other minerals are likewise the most easily floated.

In fact, the fine sizes could be floated from the pulp to some extent without the addition of any oil. A froth made in this manner contained 9.5 per cent of ash. If too much oil was added at any time, a very bulky froth formed quickly and overflowed all sides of the machine. On that account the oil should be very well mixed into the pulp before any froth is permitted to form.

Oils

Referring to the tables, it will be seen that the best results were obtained with a mixture of six parts of alpha-naphthylamine, usually known as X-cake, and 4 parts xylidine, as it produced the cleanest concentrate and a high percentage of recovery. A mixture of one part xylidine with four parts Calol D4 (a petroleum distillate) also gave good results. Pine oil, aqueous solutions of phenol and hardwood creosote were not good oils, as they gave a very dirty concentrate. In general, rather thin fluid oils seemed to work best. The consumption of the various oils varied from 0.42 to 1.11 lb. per ton of coal.

Discussion of Tests

By referring to test 3, the one with xylidine-X-cake mixture, it can be seen that the total recovery is 97.7 per cent in the form of a concentrate containing 13.22 per cent ash. This result is far better than would be expected from other tests. The first and second concentrates contained 11.15 and 11.79 per cent ash respectively, but the third concentrate contained 24.5 per cent ash. The same general condition is true in the other tests. This suggested that the third concentrate ought not to be combined with the two others but ought to be regarded as a middling product and re-treated. Consequently all the middlings from the first sixteen tests were combined to give enough feed for a re-treatment test. This is test No. 17. Its feed averaged 29.3 per cent ash and it gave a concentrate averaging 20.30 per cent ash with a 95.6 per cent recovery of combustible.

This seemed to indicate that the coal was very easily floated but that clean flotation in one operation was difficult. Re-treatment of all the various products seemed to be in order, and this procedure was later carried out.

Flotation of Coarser Coal

Previous work by A. P. Wichmann indicated that better flotation could be obtained with 35-mesh material, so another lot of coal was crushed dry to pass a 35-mesh sieve. This was part of the sample that had been used in the sink-and-float test. The same machine

TABLE VI—SUMMARY OF FLOTATION TESTS ON DRY-CRUSHED COAL UNDER 35-MESH, CALCULATED ON MOISTURE-FREE BASIS

Sample: Dry-crushed coal under 35-mesh, 500 grams
Assay of the sample: 23.35 per cent ash
Water used: 3,500 c.c.
Machine: Ruth laboratory flotation machine, junior
Speed: 1,200 r.p.m.
Duration of test: 1st conc., 10 minutes; 2nd conc., 10 minutes; 3rd conc., 10 minutes
Temperature of water: 22 deg. C.
Pulp dilution: 1:7.

				1st Concentrate				2nd Concentrate					3rd Concentrate					Tailing		
Test No.	Size in Mesh		Kind of Oil Used	Weight, Per Cent	Ash, Per Cent	Oil, Lb. Per Ton	Per Cent Recovery of Pure Coal	Weight, Per Cent	Ash, Per Cent	Cumulative Amount of Oil, Lb. Per Ton	Cumulative Recovery, Pure Coal, Per Cent	Average, Per Cent Ash	Weight, Per Cent	Ash, Per Cent	Cumulative Amount of Oil, Lb. Per Ton	Cumulative Recovery of Pure Coal, Per Cent	Average Ash, Per Cent	Weight, Per Cent	Ash, Per Cent	Elimination Ash, Per Cent
18	On	48	4 pt. gas-house tar....	81.82	18.30	0.18	88.3	.....	.....	....	....	.....	.....	.....	....	....	.....	18.18	57.3	41.0
19	On	48	1 pt. pine oil..... X-cake ..... Xylidine.....	7.85	9.52	0.63	9.4	39.02	13.55	1.27	53.8	12.88	44.28	27.92	2.11	95.4	20.18	8.85	64.15	23.1
20	On	48	Coal-tar creosote.....	14.54	10.05	0.21	17.5	34.15	14.41	0.33	56.7	13.11	45.05	32.09	0.59	97.6	22.24	6.26	72.8	18.0
21	On	65	Coal-tar creosote.....	13.15	9.42	0.21	15.7	37.80	12.64	0.34	59.4	11.80	40.27	29.48	0.59	96.9	19.61	8.78	73.1	26.4
22	On	80	Coal-tar creosote.....	37.48	8.94	0.21	43.9	29.52	15.52	0.34	76.0	13.92	25.46	35.73	0.59	97.5	18.40	7.54	75.8	25.6
23	On	100	Coal-tar creosote.....	30.25	7.95	0.20	36.3	33.13	13.78	0.32	73.5	11.01	25.00	32.54	0.50	95.6	17.20	11.62	71.6	35.4
24	On	200	Coal-tar creosote.....	51.96	10.54	0.20	60.4	23.44	20.75	0.32	84.5	13.53	12.30	35.54	0.50	94.9	16.78	12.30	68.3	36.4
25	Through	200	Coal-tar creosote.....	27.80	9.12	0.14	32.4	51.40	16.28	0.56	87.5	13.77	13.20	45.30	0.72	96.8	18.28	7.60	66.1	23.0

was used for testing, but the pulp density was 7:1 and the duration of the test was shortened to 10 minutes.

Effect of Size of Particle

The first tests with this material were on different sizes removed from the crushed sample by screening. The data on these tests are contained in Table VI.

In the tests it was noticed that the finer sizes of coal floated much more easily than the coarser. In test 24 the froth which formed without the addition of any oil was collected as the first half of the first concentrate and was found to contain 9.35 per cent ash and the recovery was 27.6 per cent of the total clean coal. The material used for this test passed a 100-mesh screen and was retained on a 200-mesh screen.

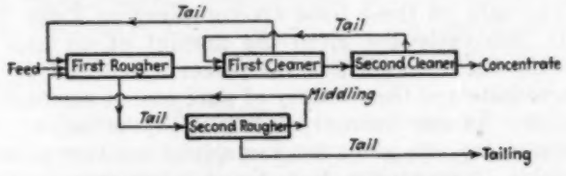
With the exception of the slimed material which passed a 200-mesh screen, the finer the size of material the cleaner the concentrate, other conditions being equal. Evidently the slimed coal is detrimental to the obtaining of clean concentrate. The first concentrate contained only 8 to 10 per cent ash in all the tests, and this suggested that either it was the cleanest coal which floated first or the later froths should be regarded as middling and re-treated.

Again the xylidine-X-cake mixture showed itself superior to other oils in obtaining clean concentrate even with coarse material.

Repeated Froth Flotation

Based on the inferences gained from the above work, we then carried out three series of tests according to definite flow sheets, in which both the tailing and the concentrate of the rougher cell were re-treated and middling returned for re-treatment. The Ruth machine was used and various fractions of the coal from these tests were set aside, each to take its turn in following out the flow sheet, since each operation mentioned in the flow sheet had to be done in the one machine. The water was re-used in each test in order to recover as much of the flotation oil as possible. The complete set of operations in following out such a flow sheet was called a "locked test."

As seen in flow sheet No. 1, the concentrate from the first rougher cell was cleaned and then recleaned, middling from each operation being returned to the next machine ahead. The tailing from the first rougher was treated in a second rougher to recover any coal not floated in the first rougher and return it to the main feed. The coal for this test was crushed dry to pass a 65-mesh screen and the first roughing took place at a pulp dilution of about 1:7. The oil used was the X-cake-xylidine mixture previously found most effective. This locked test involved twenty individual flotation operations on eight samples of coal. The results are summarized in Table VII. A screen analysis was made on the feed and on the concentrate and these analyses are included in the table.



FLOW SHEET OF LOCKED TEST NO. 1

It was disappointing to find such a high percentage of ash in the final concentrate and also to find that the intermediate products all through the system which were being returned for further treatment were so high in ash as to be almost capable of going into the tailing. The original coal contained 23.42 per cent ash and the concentrate of this series of tests contained 17.10 per cent ash, with a recovery of 95.5 per cent of the pure coal. Evidently this is the wrong flow sheet. High oil consumption suggested overoiling and consequent dirty concentrate. It was also thought that too

TABLE VII—SUMMARY OF LOCKED TEST NO. 1

	Oil, Lb. Per Ton	Recovery, Per Cent	Weight, Per Cent	Ash, Per Cent
Concentrate	2.16	95.5	87.85	17.10
Tailing from 2nd cell	....	....	0.38	71.62
Tailing from 1st cell	....	....	0.68	75.55
Middling from 2nd rougher	....	....	3.79	57.60
Tailing	....	....	7.30	77.85
Total elimination of ash			36.5	per cent

	Screen Analyses Feed—65-mesh		Concentrate	
Screen Mesh	Weight, Per Cent	Ash, Per Cent	Weight, Per Cent	Ash, Per Cent
On 80	34.90	24.21	16.47	14.59
On 100	4.88	24.38	5.70	15.78
On 150	9.24	23.33	16.38	16.65
On 200	31.37	23.07	45.70	18.07
Through 200	19.61	22.58	15.75	17.89
Total or average	100.00	23.42	100.00	17.10

TABLE VIII—SUMMARY OF LOCKED TEST NO. 2

	Oil, Lb. Per Ton	Recovery, Per Cent	Weight, Per Cent	Ash, Per Cent
Concentrate	0.43	91.5	82.82	15.41
Tailing from 2nd cell	.....	.....	2.61	43.49
Tailing from 1st cell	.....	.....	2.33	54.45
Middling from 2nd rougher	.....	.....	2.61	56.35
Tailing	.....	.....	9.63	70.86
Total elimination of ash				45.6 per cent

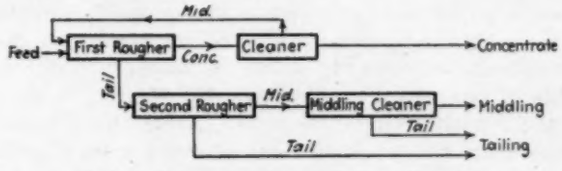
Screen Analyses

Screen Mesh	Feed—20 Mesh Weight, Per Cent	Feed—20 Mesh Ash, Per Cent	Concentrate Weight, Per Cent	Concentrate Ash, Per Cent
On 28	5.38	28.27	0.32	13.50
On 35	22.34	26.70	10.70	12.77
On 48	18.83	25.12	18.85	13.08
On 65	15.07	23.60	16.63	13.77
On 100	11.07	23.85	18.35	17.19
On 200	14.68	23.52	22.48	18.88
Through 200	12.63	23.33	12.67	18.05
Total or average	100.00	23.51	100.00	15.41

much slime was present in the pulp and that coarser crushing would be beneficial. The screen analysis of the concentrate showed more ash in the finer sizes.

Following out this idea, we ran a second series of tests with material crushed to pass only a 20-mesh sieve, following the same flow sheet. Crude wood turpentine was used as an oil, and we were careful to avoid oiling. This test, as compared with the first one, involved changing three variables, but these "locked" tests involved so much labor that we thought it best to reason out the best set of conditions as indicated by previous tests and try them immediately rather than to carry out laboriously a whole series of tests, changing only one variable at a time.

The results of this second series of tests are summarized in Table VIII.



FLOW SHEET OF LOCKED TEST NO. 2

The concentrate in this case contained 15.41 per cent ash and a recovery of 91.5 per cent of the pure coal was made. Again the intermediate products were too low grade and showed that they should not be combined with the feed in the way that they were. The concentrate has probably been considerably contaminated by the return of these high-ash products. The ash content of the various sizes in the concentrate seemed to increase distinctly with decrease in size. The screen analyses also show that a good deal of coal is further broken up during the flotation, possibly due to the action of the Ruth impeller.

From these results it seemed best to use a flow sheet in which complete flotation of everything from each cell would leave a tailing which could be discarded immediately. Flow sheet No. 2 meets this condition.

The coal was dry crushed to pass a 20-mesh screen and the head sample contained 23.51 per cent ash. Other tests on this size of material indicated that the concentrate would contain 20 per cent ash if over a 95 per cent combustible recovery was attempted. Screen analyses were made of the feed, concentrate, middling and tailing. The X-cake-xylidine mixture, with sufficient lime water to impart distinct alkalinity to the pulp, was used. All water from the tailing and concentrate was recovered and used in order to economize on oil. The data on this locked test are contained in Table IX. No attempt was made to float all the coal in the first rougher.

This method of operating gave more favorable results, although a much larger middling product was produced. We concluded that the coal must contain particles of various ash contents varying from the almost pure coal, through bony coal, bone and bituminous shale to pure shale or ash. If this be true, and the sink-and-float work seems to bear this out, a flow sheet should be adopted which divides the coal into clean concentrate and bony middling as was done in this test. The concentrate contained only 10.76 per cent ash with a recovery of 63.68 per cent of the pure coal and if the middling is included with the concentrate the ash analysis would be 15.07 per cent with an extraction of 88.88 per cent. The oil consumption was 2.26 lb. per ton of coal.

The screen analyses show that some pulverization of the coal took place in the flotation machine. Also the cleanest sizes were those passing a 35-mesh screen and staying on a 100-mesh screen. The sizes coarser than this are presumably not crushed sufficiently to liberate the ash, while the sizes finer than this are difficult to float clean.

Discussion of Results

In all our tests it was noticed that the first material to float was the very finely divided material and that it required almost no oil for its flotation. When oil was added in any quantity this fine material was "overoiled" and tended to float in too dirty a concentrate. Microscopic examination did not show differences in appearance between the clean coal and the bone, so we had to rely entirely on the chemical analyses of the various products which we made. However, we formed the idea that the only way to combat the tendency of fine bone coal to float with coarse pure coal is to either deslime the feed and treat the two products separately by flotation, or else treat the various rougher products repeatedly in order further to differentiate them. We chose the latter as the most practical proposal.

We have not been able to prove to ourselves beyond

TABLE IX—SUMMARY OF LOCKED TEST NO. 3

Concentrate				Middling					Tailing		
Weight, Per Cent	Ash, Per Cent	Oil, Lb. Per Ton	Recovery, Per Cent	Weight, Per Cent	Ash, Per Cent	Cumulative Amount of Oil, Lb. Per Ton	Cumulative Per Cent Recovery Pure Coal	Average Ash, Per Cent	Weight, Per Cent	Ash, Per Cent	Per Cent Elimination of Ash
54.5	10.76	0.95	63.68	25.4	24.35	1.49	88.88	15.07	20.1	57.80	49.1

Screen-Analyses of Feed and Products (Moisture-Free Basis)

Screen	Feed—20 mesh Weight, Per Cent	Feed—20 mesh Ash, Per Cent	Concentrate Weight, Per Cent	Concentrate Ash, Per Cent	Middling Weight, Per Cent	Middling Ash, Per Cent	Tailing Weight, Per Cent	Tailing Ash, Per Cent
On 28	5.38	28.27	0.10	13.54	0.10	19.29	0.11	54.70
On 35	22.34	26.70	8.42	10.18	17.32	20.74	17.66	46.07
On 48	18.83	25.12	14.63	8.42	29.03	23.80	12.63	50.60
On 65	15.07	23.60	16.53	8.13	18.52	23.53	19.81	56.40
On 100	11.07	23.85	15.63	9.59	14.51	23.16	16.91	60.85
On 200	14.68	23.52	32.47	12.85	10.81	31.72	21.88	69.80
Through 200	12.63	23.33	12.22	13.56	9.71	37.75	11.00	75.20
Total	100.00	24.87	100.00	10.77	100.00	25.25	100.00	59.57

all shadow of a doubt that the finely ground coal is actually made up of particles of varying specific gravity and of varying ash content, but all data point that way, and if true, our third locked test has come very near the limit in possibility of separation, since the cleanest product shown in the sink-and-float tests contained about 8 per cent ash and the concentrate in our third locked test contained only 10.76 per cent ash. The middling product or bone from this test would probably have to be marketed as such, separately from the clean coal.

Conclusions

1. Tests on a bony coking coal from the Wilkeson mine, at Wilkeson, Wash., have shown that the cleanest coal can be floated first, the bony coal next and the ash last by ordinary froth flotation.

2. Very thin oils or soluble frothing agents work best.

3. The fine sizes of coal float the most easily and the coal in the very fine slime will float to some extent without the use of any flotation oil whatever.

4. Due to the tendency of fine sizes to float so easily, they are probably "overoiled" and produce dirty concentrate when enough oil is added to float the coarser sizes. Screen analyses of the flotation concentrate show increasing percentages of ash in the finer sizes.

5. To take due advantage of the above facts it is necessary to use a flow sheet in which roughing treatment is followed by cleaning of both concentrate and tailing from the roughing cell, discarding as tailing material which will not float in any of the re-treating cells. Re-treatment of middling with original feed is not desirable except for the middling obtained in cleaning the rough concentrate.

6. By this method of treatment a clean concentrate can be obtained, the bony portion of the coal forms a middling which may have a market value, and the tailing is too low in coal to be of any value.

7. Attempts to control the flotation tests by sink-and-float tests with heavy solutions have failed on the fine sizes of coal due to their supposed porosity.

Lead Pigments Marketed in the United States in 1920 and 1921

The following table shows the quantity and value of lead pigments marketed in the United States in 1920 and 1921 as reported by producers to the United States Geological Survey.

LEAD PIGMENTS MARKETED IN THE UNITED STATES, 1920 AND 1921

	1920			1921		
	Short Tons	Value Total	Per Ton	Short Tons	Value Total	Per Ton
Sublimed Lead:*						
White	12,412	$2,083,647	$167.87	11,568	$1,418,403	$122.61
Blue	928	153,657	165.58	463	58,593	126.55
Red lead	34,431	7,523,089	218.50	21,814	3,410,904	156.36
Orange mineral				379	91,184	240.59
Litharge	62,329	12,386,185	198.72	41,953	5,740,690	136.84
White lead:						
Dry	33,678	6,351,798	188.60	26,695	3,749,851	140.47
In oil	112,017	25,986,100	231.98	143,634	27,713,257	192.94

*Includes basic sulphate lead.

A decrease is shown in the sales of each of these pigments in 1921 as compared with 1920 with the exception of white lead in oil, in which an advance of 28 per cent was made. A decrease is also shown in the average price per ton of each product in 1921 as compared with 1920.

Recent Developments in Low-Temperature Coal Carbonization

AT A RECENT symposium on the low-temperature carbonization of coal held in Cardiff, South Wales, a number of papers were read bearing on the various processes that are being developed in Great Britain at the present time. This subject has aroused considerable interest in Great Britain, as it holds promise of utilizing the non-coking coals and fine slack and dust—a possibility of some economic importance to the country. Several items of interest were brought out during the meeting in connection with recent experimental and development work.

Critical Temperatures of Carbonization

N. H. Freeman gave some interesting facts with regard to what may be called the "critical temperatures" of various stages in the carbonization of coal, and suggested that the essential dividing line between high- and low-temperature carbonization should be taken as 800 deg. F., this being the temperature at which the complex hydrocarbons of the coal substance begin to decompose, forming free carbon and free hydrogen. It was pointed out that the first stage in the carbonization of coal is the separation of water (together with occluded gases), which begins at 212 deg. F. and continues to 500 deg. F. Another critical stage for average coals begins at about 450 deg. F. and may continue to as high as 650 deg. F. In this stage a great portion of the coal substance is transformed into a more or less soluble or semi-soluble condition, and it is only when this stage is completed that oil begins to separate. The oil begins to distill immediately afterward, within a comparatively short range of temperature, up to say 800 deg. F., depending on the constitution of the coal. After this maximum temperature the products coming over are tars, pitches, phenols, anthracenes, etc., the process being then in the nature of high-temperature carbonization. According to Mr. Freeman, coal—because of its low heat conductivity—can be submitted efficiently to low-temperature carbonization only when it is finely divided, in thin layers, and constantly agitated so that every particle is subjected to the same temperature, which must be automatically controlled at the different stages.

Low-Temperature Carbonization Applied to the Mond Process

Some new and interesting information is contained in the paper submitted by the Power Gas Corporation, Ltd., which company has been using the Mond process for the past 30 years. In the original Mond process it was possible, using cheap slack containing 1.3 per cent nitrogen, to recover ammonia to the extent of 65 to 75 per cent of the total nitrogen, equal to 85 to 95 lb. of sulphate of ammonia per ton of coal, with a yield of gas of 135,000 cu.ft. It was necessary, however, to add to the producer a very large amount of steam, about 2½ tons per ton of coal, one-third of this steam being decomposed in the producer, and two-thirds passing away in the gas, which left the producer at about 925 deg. F. About ¾ lb. of the steam is recovered, however, so that a net amount of 1¾ lb. of steam per pound of coal is required. Today this process has no longer the great economic advantages in Great Britain it formerly had, because the price of

labor, coal and sulphuric acid has increased out of all proportion to that of the sulphate of ammonia.

Consequently the Power Gas Corporation, Ltd., has now altered the original Mond process with a view to increasing both the economy and the efficiency, and now combines with it the principle of low-temperature carbonization. This new process, that of Beswick and Rambush, consists in converting as much as possible of the volatile matter of the coal into liquid products according to low-temperature methods, while the residual fuel is entirely converted into producer gas. The transmission of heat to the charge of raw coal in the upper part of the producer is claimed to be achieved in a gradual but effective and rapid manner by the employment of the sensible heat contained in the hot producer gas evolved in the lower part of the producer. That is to say, the raw coal charged into the producer is kept in the upper or primary zone at such a temperature as to get a low-temperature carbonization with the maximum yield of oils, and the residual fuel is then converted into producer gas in the lower or secondary zone. At the same time the very high yield of sulphate of ammonia, 90 lb. per ton of coal, characteristic of the original Mond process is retained, and the whole operation is carried out in one simple plant which is comparatively cheap to erect. The steam required in this new process is only about 1 lb. per pound of coal carbonized. Also, nearly all this steam is decomposed, and the saturated air blast no longer requires to be superheated. The gas evolved has an average composition of 21.0 per cent CO, 20.5 per cent H_2, 8.3 per cent CO_2, 4.9 per cent CH_4, and 45.3 per cent N_2, with a net calorific value of 178 B.t.u. per cu.ft. The yield of gas is 115,000 to 120,000 cu.ft. per ton, and the quality is very nearly as good as the ordinary hot producer gas. The amount of low-temperature tar or oil produced is about 15 to 24 gal. per ton.

Additional advantages claimed for the new process are that, because of the lower temperature in the producer, the pipe lines are smaller, the maintenance costs are reduced and the capital outlay and ground space are both much less because of the elimination of the air and steam superheaters. Also the plant is so arranged that the amount of either tar or ammonia can be easily manipulated, depending on the market.

The Maclaurin Continuous Retort

The method of internal carbonization is particularly characteristic of the "Maclaurin" process, which, in fact, differs from all others in having no external heating at all, not even steam. The continuous retort used resembles an elongated producer or small blast furnace, the height being about 40 ft. and the width at the combustion zone about 8 ft. The raw coal is charged in at the top and passes slowly down the retort, the residual fuel being withdrawn at the bottom. The carbonization is carried out by the heat produced by the combustion of a portion of the charge in the lower part of the retort. The hot products of combustion pass upward, gradually heating the coal in the upper layers, and carrying with them the volatile products given off, which are then condensed by the charge of cold coal entering the top of the retort, the oil and other products being separated by patent oil traps so that they do not trickle back into the hotter regions. The period of carbonization is 20 hours, and it is stated that any size of coal can be used up to pieces that will pass through the bell, which is 8 to 9 in. in diameter.

The residual smokeless fuel in the ordinary method of working has been formed at a temperature of about 1,300 deg. F. and contains about 4 per cent volatile matter. It is black in color and is easily ignited like ordinary coal. The heat losses of the process are said to be small, being confined to the radiation from the plant, the heat lost in the hot coke and the gases leaving the producer.

The oil is of peculiar composition, being similar to low-temperature oil in that it has no naphthalenes and anthracenes, but differs in having no light oils, although there is present a very high percentage of cresols and xylenols, up to 50 per cent of the total oil, and including an exceptional amount of high-boiling phenols. The crude oil can also be used direct as fuel oil.

The composition of the gas is 16.0 per cent CO, 13.0 per cent CH_4, 16.1 per cent H_2, 6.2 per cent CO_2, and 48.1 per cent N_2. No hydrocarbons except methane are present, because the oils are not "cracked" during the process of carbonization. The yield of sulphate of ammonia is 24 lb. per ton, the ammonia liquors being free from ferrocyanides and sulphocyanides, but containing di- and tri-hydroxy phenols.

The further yield by this process from 1 ton of coal (12,300 B.t.u.) with 35 per cent volatile matter and 7.7 per cent water, is 1,096 lb. of residual smokeless fuel, 15.6 gal. of oil and 27,731 cu.ft. of gas at 247 B.t.u., the total loss in the whole process being 11.3 per cent of the coal. It must be pointed out, of course, that in comparison with other processes these figures must be increased by about 15 per cent, since no external producer gas is required.

Pure Coal Briquets

The free-burning properties of low-temperature fuel depend to a considerable extent on the structure of the fuel as well as on the proportion of volatile matter. In discussing the merits of low- and high-temperature carbonization for the production of smokeless fuel, Edgar C. Evans brought out the importance of this consideration, stating that coals which contain little resinic matter and do not fuse or swell during carbonization always give a free-burning coke, because such coke is of quite different structure from the sponge-like substance of ordinary gas or furnace coke, the pores being very much smaller and the whole structure much more granular. Also, this free-burning coke is not impregnated with a film of graphite, which covers ordinary coke and renders it so incombustible.

The "pure coal briquet" (Sutcliffe-Evans) process consists in roughly pulverizing the coal and mixing it with about 20 per cent of pulverized coke breeze or other product from the carbonization of coal. This mixture is then briquetted in a special briquet press at a very high pressure, 10 tons to the square inch, giving perfectly hard briquets without the use of a binder such as pitch. These briquets are now carbonized by means of producer gas at high temperatures, say 1,600 deg. F., the heated inert gas passing through the mass of the briquets in a simple type of retort which is merely a vertical cylinder. These briquets have the remarkable property that they do not expand on carbonizing, so that existing gas-works or coke-oven retorts can be used. Also, although the residual fuel contains only about 2 per cent of volatile matter, it is easily ignited like ordinary raw coal, because of the peculiar fine grain structure which, under the microscope, is seen to resemble charcoal.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Committee Recommends Acceptance of Ford Offer —Inclusion of Gorgas Plant Only Disagreement

Consideration of the disposal of the Muscle Shoals property of the government has been transferred from the Committee on Military Affairs to the House of Representatives proper. A majority of the members of the Military Affairs Committee recommends the acceptance of the Ford offer with the elimination of the steam plant at Gorgas and of the transmission lines connecting it with the No. 2 nitrate plant. The majority also insists on a rewording of the fertilizer guarantee and other amendments of less importance. A minority of the committee will recommend the acceptance of the offer as finally amended on May 31 by Mr. Ford. Every effort will be made to obtain prompt consideration of the matter on the floor of the House.

Revised Fertilizer Provisions

The new fertilizer clause, upon which a majority of the committee insists, reads as follows:

> Since the manufacture, sale and distribution of commercial fertilizer to farmers and other users thereof constitute one of the principal considerations of this offer, the company expressly agrees that, continuously throughout the lease period, except as it may be prevented by reconstruction of the plant itself, or by war, strike, accident, fires or other causes beyond its control, it will manufacture nitrogen and other commercial fertilizers, mixed or unmixed, and with or without filler, according to demand, at Nitrate Plant No. 2 or its equivalent, or at such other plant or plants, adjacent or near thereto as it may construct, using the most economical source of power available. The annual production of these fertilizers shall have a nitrogen content of at least 40,000 tons of fixed nitrogen, which is the present annual capacity of Nitrate Plant No. 2. If during the lease period said Nitrate Plant No. 2 is destroyed or damaged from any cause the company agrees to restore such plant, within a reasonable time, to its former capacity.

Ford Insists on Inclusion of Gorgas Plant

W. B. Mayo, representative of the Detroit manufacturer, declared that he regarded the action of the committee as a decisive victory for Mr. Ford and that a more determined effort than ever before would be made to obtain the properties. He felt that agreement on all points but one—the Gorgas plant—was a distinct achievement.

That Mr. Ford is anxious to have the Gorgas steam plant included in the terms of the lease is evident from a letter which he addressed to the Military Affairs Committee, just prior to the action of that body. He declared in this letter that he would not consider taking over the property unless the Gorgas plant is included. The full text of the letter is as follows:

> I have carefully examined the amendments made by your committee to my proposal dated Jan. 25, 1922, for the lease and purchase of the government's Muscle Shoals properties, and observe with surprise and regret that you have rejected that part of the modified proposal relating to the government's Gorgas steam plant.
>
> The greater portion of the other changes suggested by your committee have been approved and are incorporated in the accompanying corrected proposal. More than a month ago Mr. Mayo presented to me certain clarifications in the proposal of Jan. 25 to which your committee desired my agreement, which was promptly given. Mr. Mayo explained that while some of your committee were unwilling to accept that part of my offer which included the government steam plant at Gorgas, certain other members of the committee had requested him to ascertain if I would agree to accept an assignment and transfer by the United States of everything now owned by the government at Gorgas under its contract of Dec. 1, 1917, with the Alabama Power Co., to which I assented, and Mr. Mayo was instructed to advise your committee that the offer would be revised accordingly. I have been informed that this revision was accepted by your committee, but later, upon reconsideration, you decided to eliminate the Gorgas plant.
>
> I cannot consent to eliminate the Gorgas plant, because it is necessary to the economical operation of the Muscle Shoals properties. If my revised offer for Gorgas is rejected, then I must understand that the acceptance of my offer for Muscle Shoals "as a whole and not in part" is refused.
>
> I am sending a final proposal containing all the amendments suggested by the committee to which I can consistently agree. In doing so, and in view of the fact that my first proposal was signed July 8, 1921, *nearly a year ago*, and in order to bring these negotiations to a close, I ask that your committee consider this proposal as final, and that no further changes should be expected. I further request that your committee send this final offer to the House so that its members may vote for acceptance or rejection. This request is made with the understanding that power to dispose of the plants at Muscle Shoals is vested in the Congress. If the Secretary of War after his negotiations relative to the first offer did not have the power to accept or reject it, you will probably agree that your committee has not the power to accept or reject it. Moreover, I do not believe that your committee or any member of it wishes to assume the responsibility of accepting or rejecting this final proposal, involving as it does a matter of such great national importance.
>
> If Congress votes acceptance of my offer, we will get on the job at Muscle Shoals at once; but if Congress rejects it, that will be but the beginning of a more determined effort on my part to save Muscle Shoals for the benefit of the public.
>
> I wish to thank you and each member of the committee for the courtesies shown my representatives during the negotiations of the past three months.

Appropriation for Completion of Dam Approved

Another important development in Congress affecting Muscle Shoals while the committee was in session was the adoption in the Senate of an amendment to the War Department appropriation bill proposed by Senator Norris, on behalf of the Senate Agricultural Committee, appropriating $7,500,000 for continuing work on Dam No. 2. Senator Norris stated that it would take 3 years to complete the dam and develop power there and that the project would cost about $22,500,000. The War Department appropriation bill with the Muscle Shoals appropriation was passed by the Senate and will go to a conference with the House, which has already passed the bill.

Will Not Interfere With Lease Proposals

In the discussion of the amendment, Senator Jones of Washington asked what effect the amendment would have on the lease proposal of Henry Ford. Senator Norris replied that the construction of the dam would not interfere with any of the lease proposals before the committee and about which there was difference of opinion. Senator Lenroot of Wisconsin stated that he had previously opposed completion of the dam on the ground that the Alabama Power Co. would be the only customer for the power. He is now inclined to favor the construction of the dam, however, as the situation has changed and if the dam is completed he thinks there will be no difficulty in securing a fair price for power, as there will be sufficient demand for it.

Final Program for Niagara Falls Meeting of American Institute of Chemical Engineers

The final program for the fourteenth semi-annual meeting of the American Institute of Chemical Engineers at Niagara Falls, Canada, June 19 to 21, has been distributed to members. The features are arranged exactly as published in CHEM. & MET. of May 3, with the execption of a few additional papers not announced at that time.

Clifford D. Carpenter and Joseph Babor will present a paper at the acid symposium on "Concentrating Dilute Nitric Acid Solutions." S. L. Tyler will discuss the "Absorption of Hydrochloric Acid or Other Gases." The Production of Hydrochloric Acid From Chlorine and Hydrogen" is the subject of a newly scheduled paper by H. K. Moore.

Problems in transportation of acids and corrosive chemicals will receive the attention of the meeting at the Thursday morning session. Contributions to this symposium will be made by J. M. Rowland, who will discuss the transportation of hydrochloric acid in tank cars, and F. C. Zeisberg, who will describe and discuss the "Hard Rubber-Lined Steel Tanks for the Transportation of Hydrochloric Acid." Another paper of interest on this general topic has been prepared by J. L. K. Snyder and H. P. Wells entitled "Transportation of Liquid Chlorine in 15-Ton Tank Cars."

In addition to the strong technical program, arrangements have been made for very delightful entertainment features, particularly for the visiting ladies. Automobile trips, luncheons, teas, theater parties and sightseeing trips will occupy their time during the technical sessions.

Industrial Advertisers in National Conference Will Discuss Marketing to Industries

As a new feature of the annual convention of the Associated Advertising Clubs of the World, which will be held in Milwaukee, Wis., June 11 to 15, a conference on Industrial Advertising is scheduled. It is proposed to make the Industrial Advertising Conference an annual affair, offering opportunity for the discussion of problems arising in connection with the marketing of goods to industry, as contrasted with the marketing of goods from industry to the individual consumer. Keith J. Evans, advertising manager Joseph T. Ryerson & Son, Chicago, is chairman of the conference.

Among the addresses scheduled for the first session, Monday afternoon, June 12 are the following:

"Advertising as a Factor in Interindustrial Marketing," by M. W. Babb, vice-president Allis-Chalmers Manufacturing Co.

"What the U. S. Department of Commerce Is Doing to Aid Interindustrial Marketing," by F. M. Feiker, vice-president of the McGraw-Hill Co. As personal assistant to Mr. Hoover for nine months, Mr. Feiker was engaged in reorganizing the three bureaus of the Department of Commerce which are designed to serve industry. He will describe the new purposes of the department in relation to interindustrial marketing and in addition will bring a personal message from Mr. Hoover to the Industrial Advertising Conference.

"Cutting the Costs of Distribution," by Sydney Anderson, Congressman from Minnesota.

"Advertising in Its Relation to the Four Points of Contact in Industry," by Bennett Chappel, director of publicity, American Rolling Mills.

On June 13 Charles H. Mackintosh, of La Salle Extension University, will talk on "Advertising the Technical Product to the Non-Technical Buyer." J. C. McQuiston, of the Westinghouse Co., will speak on "Selling to the Professional Man in Industry." Mr. McQuiston will discuss the influence of the architect, engineer, chemist and others who have a professional relationship to the buying of industrial products, which presents an important problem in the development of interindustrial markets. H. Colin Campbell, of the Portland Cement Association, will talk on "Expanding the Markets for Raw Materials," and W. Lee, vice-president of Frank D. Chase, Inc., on "Putting Ideas Into Industrial Advertising."

A large and complete exhibit of the best advertising in the country has always been a feature of the conventions of the Associated Advertising Club. This year there will be an exhibit of advertising showing effective methods of mass-selling to interindustrial markets in connection with the Industrial Advertising Conference. The McGraw-Hill Co., Inc., has offered a beautiful silver cup for the best complete campaign and a watch fob for the person who prepared it. Other companies are planning additional prizes which as yet cannot be announced.

Sales and advertising executives and all others interested in industrial marketing are cordially invited to attend the sessions of the Industrial Advertising Conference. It is unnecessary to be a member of any advertising club or organization.

National Fertilizer Association Program for Convention at White Sulphur Springs

The program of the twenty-ninth annual convention of the National Fertilizer Association, which will be held at the Greenbrier, White Sulphur Springs, W. Va., June 12 to 15, inclusive, has been completed. The business sessions promise to be of more than usual interest this year. Reports of standing committees will be presented, and subjects of current importance to the fertilizer industry will be discussed on the floor of the convention. In addition, M. Harcourt Paine and General O. K. Chance, both prominently indentified with the British fertilizer and chemical industries, will be present and address the convention.

The detailed program of the convention follows:

MONDAY, JUNE 12

10 a.m. Subscribers' meeting—Soil improvement committee of the National Fertilizer Association.

12 m.—Committee meeting—Soil improvement committee of the National Fertilizer Association.

3 p.m. Committee meeting—Southern soil improvement committee.

8 p.m.—Meeting of executive committee, Southern Fertilizer Association.

TUESDAY, JUNE 13

10 a.m.—Meeting of Southern Fertilizer Association.

2.30 p.m.—Golf, tennis and quoit tournaments.

4 p.m.—Tea dance at the clubhouse.

8.30 p.m.—Meeting of executive committee, the National Fertilizer Association.

9 p.m.—Informal dance.

WEDNESDAY, JUNE 14

10 a.m.—First business session, the National Fertilizer Association.

Address by Charles H. MacDowell, president of the National Fertilizer Association.

Reports of standing committees.

Address by M. Harcourt Paine, London, England, manager of the Chilean Nitrate Committee. Subject, "The Chilean Nitrate Industry and Its Propaganda."

Discussion of subjects of importance to the fertilizer industry.

12:30 p.m.—Official convention group photograph.

2 p.m.—Golf, tennis and quoit tournaments.

3 p.m.—Ladies' bridge tournament.

9 p.m.—Novelty convention dance.

THURSDAY, JUNE 15

10 a.m.—Second business session, the National Fertilizer Association.

Reports of committees.

Remarks by General O. K. Chance, London, England, first vice-president of the British Cyanides Co., Ltd.

Discussion of subjects of importance to the fertilizer industry.

Election of executive committee.

2.30 p.m.—Golf, tennis and quoit tournaments.

8 p.m.—Organization meeting of the new executive committee of the National Fertilizer Association.

9 p.m.—Informal dance and distribution of golf, tennis, quoit and bridge prizes.

First Section of Dye Tariff Schedule Adopted—Fight Expected on Finished Dyes and Embargo

The first test vote in the controversy over the protection of the American dye and organic chemical industries approved the committee amendments to the tariff bill after a 5-hour fight on the floor of the Senate. The approved amendment proposes a duty of 50 per cent ad valorem and 7 cents a pound on crude coal-tar dye products. The vote was 37 to 20, three Republicans opposing the amendment and one Democrat supporting it. The controversy over the 60 per cent and 7 cents a pound duties proposed on intermediates and the modified dye embargo provisions of the bill went over, as the Senate turned attention to a consideration of the brick schedule immediately after this one vote.

This action was regarded as a forecast of the approval of the other rates on finished dyes, but cannot be interpreted as any indication of what action will be taken on the embargo feature of the controversy. It is expected that action will not be taken on the embargo provision until it is reached in the administrative section of the bill.

King Voices Opposition

As expected, Senator King, armed with a mass of data and documents, opened an attack on both the rates and on the embargo. In a 5-hour speech he reviewed the dye situation, assailing the present control act which, he asserted, was passed during the war "as a result of misrepresentations by Dr. Herty and other propagandists and lobbyists of the dye interests." He asserted that the bill had gone further than the public or the Senate had foreseen when interpreted as covering all compounds of a synthetic organic nature. He assailed the embargo as un-American. "An embargo is not protection," he declared, "it is exclusion. It is the establishment by law of monopoly."

Returning to his disapproval of the rates on coal-tar products, Senator King declared that we are in a position to compete with the world in the production of crudes, intermediates and dyes, yet we are especially gracious to the coal-tar industry. He added that he would later call attention to the corporations, their ramifications, the immense amount of capital and the influence they command, which would profit by protective legislation.

Frelinghuysen Champions Protection

Senator Frelinghuysen, of New Jersey, answered by saying that even if we have the immense amount of coal referred to by the Utah Senator, the byproducts are of no value if intermediates and finished dyes are not protected. Lack of protection of these, he said, makes the products of the coke ovens valueless.

Senator Frelinghuysen in a very brief statement declared that the rates of 50 per cent on intermediates and 60 per cent on finished dyes, which are coupled with a 7-cent specific, are sufficient only to meet the difference in the cost of production here and some of the prices on imported dyes. He added that the Tariff Commission has declared that no ad valorem nor specific rate could be provided that would afford the protection needed by the industry.

The New Jersey Senator gave a brief history of the coal-tar industry. He stated that it is now in a position that makes the United States independent of the world as to dyes, but unless there is a restricted license which will permit the chemists to continue their research and experiments, the industry cannot live.

Expect Further Opposition From King

It is expected that Senator King will continue his fight for a reduction in the dyes tariff. It is probable that the Utah Senator will propose an amendment reducing the 7-cent specific duty to 3½ cents per pound on all dyes and intermediates selling at 10 cents a pound or less.

Another feature against which he is understood to be preparing an attack is that which calls upon the Secretary of the Treasury to prescribe standards of strength for dyes brought into the United States to be used as a basis for the levying of the specific rate of duty. He points out that certain dyes have come into the United States in 20 per cent strength, although perhaps the usual importations are of 60 per cent strength. Under the terms of the provision, he declares, it will be incumbent upon the Treasury Secretary to adopt the lower figures, whereupon the product of greater strength will have to pay triple rates by reason of being three times the strength of the minimum, or 21 cents per pound.

Chemical Glassware Rates Adopted

Considerable time was devoted to discussion of the rates on chemical, metallurgical and other glassware. Senator Frelinghuysen made an extended speech explaining the need for proper duties to protect the American industry from foreign competition, exhibiting samples of products of both foreign and American production. He spoke particularly of glassware used in the chemical industry. He declared that this glassware industry was one of the most important in the country, and read a letter from C. L. Parsons, secretary of the American Chemical Society, urging proper duties on glassware used in the chemical industry. Among the glassware samples submitted by the New Jersey Senator were some which he said cost 12 cents to manufacture in the United States, while the German product was selling in New York at 7.3 cents. A graduated cylinder costs 32 cents to manufacture in this country, while the German product sold for 17 cents in New York, he said.

That any effort to place chemical glassware on the free list is foredoomed to failure is indicated by the vote on an amendment by Senator Jones of New Mexico, attempting to reduce the duty from 75 to 45 per cent ad valorem, which was rejected by the decisive vote of 40 to 26.

Cyanide Put on Free List

For the first time since the tariff bill has been under discussion the Senate overrode the Finance Committee when it voted 46 to 14 to restore cyanide to the free list. Chairman McCumber of the Finance Committee, actively assisted by Senator Frelinghuysen of New Jersey, made a hard fight to hold in the bill 10 per cent ad valorem duty on "potassium cyanide, sodium cyanide, all cyanide salts and cyanide mixtures, combinations and compounds containing cyanide."

The amendment transferring cyanide from the dutiable schedule to the free list was introduced by Senator Oddie of Nevada, who contended that the gold-mining industry is entitled to free cyanide. Senator Frelinghuysen in opposing the amendment established beyond fear of contravention the fact that the officers and employees of the Roessler & Hasslacher Chemical Co. were entirely loyal throughout the war. Senator Sterling of South Dakota did not question the loyalty of the company during the war, but stated that, in addition to its being the only producer of cyanide in the United States, it has intimate connection with the interests which control cyanide production in Germany and in England.

Senator Pittman declared that, regardless of opinions one way or another about the Roessler & Hasslacher company, certain facts are uncontroverted. The control of the stock now is in the hands of the Alien Property Custodian; the company was organized by two men sent to the United States by the German syndicate; the company has had no competition in the manufacture of cyanide since its establishment in 1885; the concern always has been and now is the exclusive manufacturer of cyanide in this country; it is the sole distributor of imported cyanide; it "manufactures at this end of the line when it pays to manufacture here and sells here the German stuff when it pays better."

Chemical Porcelain and Stoneware

The 60 per cent ad valorem duty on chemical porcelain ware and chemical stoneware was adopted after amendments of Senator Jones of New Mexico to reduce the duty to 50 or 55 per cent were defeated.

Paragraph 47 was also adopted, covering 2½ cents a pound on magnesium carbonate precipitated; ½ cent a pound on chloride; ¾ cent a pound on oxide or calcined magnesia not suitable for medicinal use.

Technical Photographic and Microscopical Society to Meet at Luncheon, June 14

The first regular meeting of the Technical Photographic and Microscopical Society will be held in the Hotel Astor, New York, on June 14. Two previous meetings of representatives of various industries interested in the application of photography and microscopy to technology resulted in the organization of this society. Since its official organization, a great deal of interest has been evidenced by individuals and firms in varied branches of the chemical and allied industries. The membership already includes representatives of the following industries: paper, explosives, heavy chemicals, fertilizer, zinc, nickel, lead, leather and rubber.

An interesting program has been arranged for the meeting on June 14. Luncheon will be served at 1 p.m., after which several brief addresses are scheduled. Suggestions will be received from members and visitors as to the future policies and program of the society.

Federated American Engineering Societies Board Opposes Licensing of Mining Engineers

A council meeting, attended by all but one or two members, of the Federation of American Engineers was held in Pittsburgh, May 26 and 27.

One of the most important acts of the board was the adoption of the report of the committee on registration of engineers, of which Colonel Arthur S. Dwight of New York is chairman. The report as adopted contains the statement "that the reasons which justify the registration of engineers responsible for public work do not apply to mining engineers."

The general sentiment of the committee is summarized in the paragraph of the report which follows:

> The registration of licensing of engineers with consequent elimination from practice of all not registered. can be supported upon only two grounds:
> (*a*) The benefit of the profession.
> (*b*) The good of the public.
> Your committee has grave doubts whether licensing can benefit the profession enough to justify the cost and annoyance of the proposed measure. Further, your committee holds it should be beneath the dignity of engineers to fence themselves against qualified competition by the artificial barrier of a statute.

The committee recommends to the societies an expression of opinion that such legislation may properly cover engineers and architects charged with responsibility for public works. The committee agreed that the reasons which justify the registration of engineers responsible for public works do not apply to mining engineers, but was unable to agree as to the wisdom or unwisdom or registration of engineers engaged in other classes of work.

Other Timely Problems Discussed

The board announced plans proposing the solution of the national problems of water power and forestry, upon which "the industrial development of the nation and the standard of living of future generations largely depends." The resolution adopted by the executive board directs the council's committee on water power, of which Colonel J. H. Pinney of Washington is chairman, to place before President Harding the facts of the situation with regard to water power development in this country. The board's action at this time, it was stated, was prompted by "the federal Water Power Commission's lack of effective and permanent personnel."

Progress in a national survey of the two-shift day in American industries was reported by the council's committeee on work periods in continuous industries. This survey, called the most extensive of its kind ever made, has been in progress for more than a year, and purposes an exposition of industrial conditions which shall form a basis for establishing the relative merits of three shifts of eight hours each and two shifts of twelve hours each. Dr. H. E. Hower of the National Research Council, Washington, is chairman of the committee.

A report from the patents committee of the council, headed by Edwin J. Prindle of New York, voiced opposition to the Stanley and Ladd bills as detrimental to American invention and industry.

Reforestation, jurisdictional awards in labor, an International Engineering Congress, aërial research, engineering representation on the Civil Service Commission, foreign relations, waste in agriculture and plans for more intensive engineering organization, as proposed by Herbert Hoover, were other topics before the council.

Thirty societies are now supporting the federation, with individual members numbering about 60,000. The Canadian Institute of Engineers has taken steps to join, and much interest in the progress of the federation is being taken by societies on other continents.

Ambitious Program of Activities Outlined for Institute of American Meat Packers

Plans for the extension of the activities of the Institute of American Meat Packers have been submitted to its membership by the executive committee. The plans were drawn up by Thomas E. Wilson, president of the Institute, and are of interest to all technical and trade associations as an example of broad vision and scientific management in industry. At the next convention of the Institute the plans will be considered and steps taken to further their consummation, provided the members concur in their adoption.

Mr. Wilson summarizes his conception of the function of the Institute in the statement that he believes the Institute ultimately should become an organization which shall be a combined trade association, industrial museum, research institute and educational institution. Elaborating on this idea, he has outlined the scope of the Institute in each of its four functions.

As an Educational Institution

As an educational institution it should do at least three things:

1. Provide for specialized collegiate education for young men tending to enter the packing industry, just as the Colorado School of Mines provides training for young men expecting to begin their work in the mining industry.
2. Furnish special training to intermediate sub-executives of promise, already engaged in the industry.
3. Conduct a continuation school for plant employees and junior office help.

As a Research Institution

As a research institution it should:

1. Develop and systematize a body of scientific and technical data for the service of the whole industry.
2. Carry on agreed researches into new scientific and technical processes common to all packers without infringing on research along individual lines being done by specific companies.
3. Conduct experiments on the extension of products and reclamation of materials, except where experiments would infringe on orginal work done by some individual company.
4. Collate and disseminate information concerning discoveries and developments having relation to the packing industry without invading material developed by particular companies.
5. Conduct merchandising surveys and commercial research work.
6. Discover waste and study means of eliminating it.
7. Test material and equipment offered to the industry.

As a Trade Association and Industrial Museum

As a trade association it should continue to do what the Institute is now doing in this direction.

As an industrial museum it should provide space for permanent exhibits of models showing modern packing-house operation, specimens and processes, and it should rent out space for exhibits of materials of industrial value and for a permanent exhibit of packing-house machinery and supplies —a sort of scientific museum and centralized market place, a gigantic permanent show window, conveniently located where packers from all parts of the country may come and view samples before making purchases and installations.

Chemical Uses of Lime to Be Discussed by Convention of National Lime Association

The chemical industry will find matters of more than ordinary interest in the program for the forthcoming annual convention of the National Lime Association, which is to be held in Cleveland, Ohio, June 13 to 16. The first day of the technical sessions will be devoted to a symposium on lime for chemical industries, taking up the problems of chemical users of lime. Special consideration will be given to the alkali, glass, soda and sulphate paper pulp, soap and textile industries.

The final program for the convention has not been distributed, but it will be practically identical with the following advance schedule:

TUESDAY, JUNE 13

Joint meetings of staff, central office and regional bureaus.

WEDNESDAY, JUNE 14

10 a.m. Assembly and presidential address.

10:30 a.m. "Lime Burning in Rotary Kilns," by Irving Warner.

Forum. Limekiln efficiency.

11:30 a.m. Symposium on "Lime for Chemical Industries."

Papers:

"Alkali Industry," by R. C. Snowden, Hooker Electro Chemical Co.

"Glass Industry," by R. R. Shively, Monongahela Glass Co.

"Soda and Sulphate Paper Pulp Industry," by G. K. Spence, New York & Pennsylvania Paper Co.

"Soap Industry."

"Water Softening," by S. C. Hadden, Editor, *Municipal and County Engineering*."

"Textile Industry," by E. R. Darling, James Milliken University.

"Sulphite Paper Industry," by P. A. Paulson.

3:30 p.m. "Observations on the Lime Industry in Europe," by John Kling and Colonel C. W. S. Cobb.

3:45 p.m. "Mechanical Handling of Lime," by H. D. Pratt.

4:30 p.m. "New Idea in Lime Barrels," by T. E. McNamara.

"What the Bureau of Mines Is Doing on Quarry Problems," by Oliver W. Bowles.

THURSDAY, JUNE 15

9:30 a.m. Symposium. Lime in Construction.

11:30 a.m. Lime in Agriculture.

Thursday afternoon will be devoted to a clambake and general good time on the lake shore.

FRIDAY, JUNE 16

9:30 a.m. "Work of the Chemical Department," by M. E. Holmes.

10 a.m. "What I Have Found Out About Lime," by F. C. Mathers, professor of inorganic chemistry at the University of Indiana.

10:45 a.m. "The Value of Research to Industrial Associations," by E. R. Weidlein.

11:30 a.m. "The Lime Association," by C. Warner.

12:30 p.m. Some New Angles on the Use of Lime in Agriculture," by J. A. Slipher.

12:45 p.m. "High Points in the Construction Department Program of Lime Promotion," by W. A. Freret.

2:30 p.m. Business session.

Newton D. Baker, former Secretary of War, will address the members at the complimentary luncheon on Wednesday.

Senate Committee Raises C.W.S. Appropriation

An increase of $250,000 over the amount allowed by the House is given for general expenses of the Chemical Warfare Service next year by the Senate Appropriations Committee in reporting the War Department bill. An appropriation is also made of $262,000 for general construction at the Chemical Warfare Service station at Edgewood Arsenal.

Civil Service Openings for Chemists

The United States Civil Service Commission announces open competitive examinations for the following positions: Chemical engineer, $3,600 to $5,000 a year; associate chemical engineer, $2,500 to $3,600 a year; associate chemist, $2,500 to $3,600 a year; assistant chemist, $1,800 to $2,500 a year. Appointees at annual compensation of $2,500 or less may be allowed the increase granted by Congress of $20 a month.

Program Announced for Canadian Meeting of American Leather Chemists' Association

An ideal combination of business and vacation is offered the members of the American Leather Chemists' Association by the program for their nineteenth annual meeting. No more beautiful location could have been selected than Lake of Bays, Ontario, Canada, where the meeting will be held, and no more interesting topics to leather chemists could have been chosen than those which make up the program. The sessions will occupy all day Wednesday, June 21, and continue through Friday noon, leaving the weekend free for the visiting members to enjoy the natural attractions of the Lake of Bays region. The detailed program follows in part:

WEDNESDAY MORNING, JUNE 21

Committee reports on: "Determination of Moisture in Leather," "Determination of Epsom Salts in Leather," "Synthetic Tanning Materials."

"Influence of Atmospheric Humidity on the Strength and Stretch of Leather," by F. P. Veitch, R. W. Frey and L. R. Leinbach.

"Comparative Observations of the Tanning Properties of Vegetable Tanning Materials, Sorbanol, and Mixtures of the Two," by S. Kohn.

WEDNESDAY AFTERNOON

Committee report on the "Determination of Oils and Greases in Leather."

"Preservation Effect of Oils and Greases in Leather," by F. P. Veitch, R. W. Frey and L. R. Leinbach.

"Distribution of Grease in Leather," by L. Balderston.

"The Mode of Occurrence of Tanning in the Living Cell," by F. E. Floyd.

"The Bacteriology of the Fresh Steer Hide," by G. D. McLaughlin and G. E. Rockwell.

"A Layman in Research," by F. M. Moffat.

THURSDAY MORNING, JUNE 22

Committee reports on: "Rapid Washing of Chromed Hide Powder" and "Determination of the Water Soluble of Leather."

"Some Observations on the Histology of Bating Skins," by C. S. Hollander.

"Progress in the Physical Chemistry of Gelatine," by C. R. Smith.

"Non-Tannins," by F. H. Yocum.

THURSDAY AFTERNOON. TANNERS' SESSION

Committee report on the "Direct Measurement of the Plumping Power of Tan Liquors."

"Time Reduction in the Tanning Process," by R. O. Phillips.

"The Practice of Curing Heavy Hides," by G. D. McLaughlin and E. R. Theis.

"The Science of Curing Heavy Hides," by G. D. McLaughlin and E. R. Theis.

"The Versatility of a Plumping Method," by H. C. Reed.

"The Plumping Power of Acids," by J. S. Rodgers.

"The Importance of Finish in the Cutting and Marketing of Sole Leather," by H. B. Smith.

FRIDAY MORNING, JUNE 23

Committee reports on "Determination of Sugar in Leather," "Determination of Sugar in Extracts," "Comparative Analyisis," "Chrome Leather Analysis" and "Color Measurement of Vegetable Tanning Solutions."

"Modern Problems in Chrome Tanning," by D. Burton.

National Public Conference on Muscle Shoals Strongly Favors Acceptance of Ford Offer

The national conference of the Southern Commercial Congress, which held a three-day session at Muscle Shoals last week, is committed to fight to the end for the disposal of the government nitrate plants and waterpower projects to Henry Ford. The conference unanimously adopted memorials calling upon President Harding and Congress to end unprofitable delay in action on the Ford offer. According to Dr. Clarence J. Owens, director-general of the Southern Commercial Congress, "every resource and method at our disposal will be used to secure immediate action and disposal of this huge project of Henry Ford."

A committee on general information, empowered and instructed to "educate the American public on the national importance of the Muscle Shoals projects and the necessity of their immediate completion" was appointed during the convention. A legislative committee, empowered to further the program adopted at the conference, was also chosen.

The memorial to the President and Congress declares that the Muscle Shoals issue is national and not local, being of vital concern to the whole country. It is set forth that Mr. Ford's offer was the only one which provides for full development of all the power possibilities of the Tennessee River and for the utilizing of the natural resources of the Tennessee Valley, including the adequate improvement of navigation. It is declared that Ford was the only bidder for the projects who gave a guarantee of cheap fertilizers on a scale which offers substantial encouragement to millions of American farmers. Adoption of the memorial came unexpectedly at the final session of the conference, which was held in Tuscumbia, one of the three Muscle Shoals cities.

Hail Ford as Public Benefactor

Chester H. Gary of Missouri, chairman of the Muscle Shoals committee of the American Farm Bureau Federation, declared that Ford's proposed development of power sites along the Tennessee River would mean "a modernized and humanized agriculture." The American farmer is interested in Muscle Shoals primarily as a potential producer of fertilizer, he declared, "but agriculturists everywhere realize the possible advantages in opening the Tennessee River to navigation and in the application generally of electrochemistry to agriculture.

"Muscle Shoals means to the farmers of America cheaper farm machinery, cheaper transportation, cheaper automobiles and more conveniences for the womenfolk to be secured by the general use of electricity and aluminum."

Mr. Gary asserted that an example should be set at Muscle Shoals of what can be done with hydro-electricity "when applied to the common good," and predicted that other projects would follow in development.

In a message to the conference from Emmett O'Neal, president of the Muscle Shoals Association of Alabama, who was absent on account of illness, it was predicted that the "overpowering sentiment which now demands acceptance of the Ford offer will, with the weight of a mighty juggernaut, crush to powder any selfish corporation or individual who may attempt to check its triumphant march toward final victory."

Personal

J. Cavalier, president of the University of Toulouse, sailed for France, June 1, after concluding a series of lectures in America.

F. G. Cottrell, formerly director of the United States Bureau of Mines and until recently head of the division of chemistry and chemical technology of the National Research Council, has been selected for the directorship of the Fixed Nitrogen Research Laboratory of the Department of Agriculture. He will succeed Richard C. Tolman, who has resigned to become professor of physical chemistry and mathematical physics at the California Institute of Technology at Pasadena. No decision has been made as to the exact date on which Dr. Tolman will turn over the work to Dr. Cottrell. It probably will be late in the summer.

J. G. Detwilder, chief chemist of the Texas Co., Houston, Tex., gave an interesting lecture on the "Manufacture of Lubricating Oils" before the members of the lectureship course at the Agricultural and Mechanical College of Texas, College Station, May 19, forming the last of a series of instructive addresses, conducted under the auspices of the Mid-Continent Oil and Gas Association.

C. R. Downs, chief chemist of The Barrett Company's research laboratory at Edgewater, N. J., will take up work at Buffalo, N. Y., in the near future, for the National Aniline & Chemical Co.

A. A. French, Forest City, Ark., temporary vice-president and state vice-president from Arkansas of the National Oil Mill Superintendents' Association, was elected president of the organization by a unanimous vote at the twenty-ninth annual convention at Dallas, Tex., recently closed. D. B. Denny, Greenville, Tex., retires as president, after having served in such capacity for two years past.

Bennett Grotta, of the Atlas Powder Co. research staff at Emporium, Pa., is to make a tour of the company's Western plants this month.

Ellwood Hendrick, consulting editor of Chem. & Met., will sail on June 10 on the Royal Main Steamer Oripesa, arriving at Southampton June 19. He will attend the meeting of the Society of Chemical Industry in Glasgow early in July and will spend several weeks in England and Scotland, returning to the United States in August.

John S. Lowman, first vice-president of the Philadelphia Rubber Works, Philadelphia, Pa., is making a tour through Europe, including France, Italy and Germany. He is expected to return late in the present month.

F. F. Renwick has been appointed director of the Redpath Laboratory of E. I. du Pont de Nemours & Co. Mr. Renwick arrived from England last month to take charge of the work on photographic emulsions.

Howard M. Raymond has been appointed president of Armour Institute of Technology. Dr. Raymond has been dean of engineering since 1903 and acting president since the death of Dr. Frank W. Gunsaulus.

John T. Wood, East Liverpool, Ohio, has been elected president of the National Brotherhood of Operative Potters, as a result of a referendum election of officers of the association, in which 8,000 potters throughout the United States and Canada participated.

Obituary

Noah Bryant, one of the founders of the Bryant Paper Co., Kalamazoo, Mich., and for half a century a leader among the paper manufacturers of the Kalamazoo Valley, died on Thursday, May 4, at the home of his daughter, Mrs. Frank H. Milham, in Kalamazoo, at the age of 83 years.

Charles Ordway, inventor of many improvements in the design of the Yaryan evaporator, died on Saturday, April 29. He was born in Massillon, Ohio, on Feb. 8, 1858, and was thus in the sixty-fifth year of his age when he passed away. Mr. Ordway had been connected with the evaporator business for thirty years. Shortly after graduating from Wittenberg College, Springfield, Ohio, in 1877, he became associated with Homer T. Yaryan, inventor of the Yaryan evaporator, and was consulting engineer for the Yaryan company, which concern he succeeded in 1916.

Ernest Solvay, prominent in invention and industry through his originating the Solvay process for the manufacture of soda, died on May 27. M. Solvay was an octogenarian, having recently celebrated his eighty-fourth birthday, and was frequently styled "the Carnegie of Belgium."

Frank J. Parry, of Patchogue, L. I., secretary of the John H. Parry Tile Co., New York, died on May 23, as a result of a fall.

Market Conditions

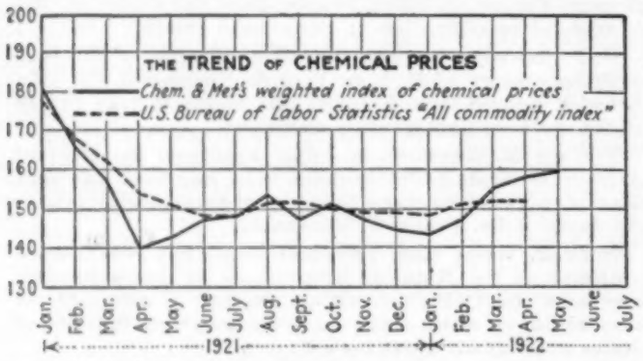
IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

Better Business Conditions in the Chemical and Allied Industries

Marked improvement in the fundamental business situation is evident in practically every branch of industry. Striking progress was made during the past month, not only in production but also along distributive and consuming lines. Basic industries, such as those producing chemical and metallurgical products, have been especially affected by the business revival, since for the most part the fabricating industries are dependent upon them for the crude raw materials of commerce.

The phenomenal building boom which is spreading over the entire country is of broad industrial significance, for it means less unemployment and, therefore, increased purchasing power. The construction industry, according to the *Commerce Monthly*, is second only to agriculture when measured in the terms of the number of persons employed. It is natural, then, that much of the improvement in the so-called process industries is directly attributable to new



building. The F. W. Dodge Co. reported that the value of new construction in April, 1922, in twenty-seven northeastern states amounted to $353,161,900, which is far in excess of any month ever reported. The previous record month was July, 1919, with $317,698,000.

This activity has contributed greatly to the demand for metals. The iron and steel industry in April was operating at 75.2 per cent of its capacity. Steel ingot production of 2,896,966 tons was the largest output in any month since November, 1920, and was more than three times that of July, 1921. The output of pig iron in April, 2,072,114 tons, was the largest since January, 1921, and was over two and a half times that of last July. The orders for fabricated structural steel were almost equal to the capacity of fabricating firms, according to the Department of Commerce. Sales reported during April amounted to 115,247 tons by seventy-five firms having a capacity of 116,918 tons, or at the rate of 99 per cent of capacity.

CHEMICAL & METALLURGICAL ENGINEERING'S WEIGHTED INDEX OF CHEMICAL PRICES

Base = 100 for the year July 1, 1913, to June 30, 1914

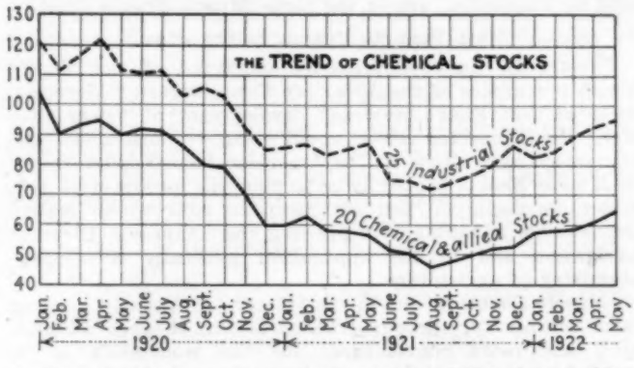
This week	158.12
Last week	157.72
June, 1917	222
June, 1918	272
June, 1919	229
June, 1920	274
June, 1921	147
April 1918 (high)	286
April, 1921 (low)	140

This index number is based on the wholesale prices in the New York market for acetic acid, citric acid, hydrochloric acid, nitric acid, sulphuric acid, ethyl alcohol, methanol, anhydrous ammonia, ammonium sulphate, barium chloride, bleaching powder, borax, caustic potash, caustic soda, copper sulphate, formaldehyde, glycerine, potassium carbonate, saltcake, soda ash, crude sulphur, benzene, aniline oil, cottonseed oil and linseed oil.

Progress in the Process Industries

Other process industries prospering on account of the building boom include the production of glass, enameled ware and paint and varnish. One of the world's largest paint-manufacturing firms recently reported to the Philadelphia Reserve Bank that its gallonage production of house paint has increased 35 per cent over 1920 and over 30 per cent above 1921. The latter year, it will be recalled, was unusually good for the paint industry notwithstanding the general industrial depression.

The rubber industry, favored by low prices for its raw materials and a record demand from the automobile manufacturers, is working with feverish activity. The Philadelphia Bank sponsors the statement that tire production at Akron is at the rate of 85,000 tires a day. Even in the peak



of 1920 the daily output was but 110,000. This fact carries most significance when it is considered that before the depression it took 72,000 men to produce these tires, while today 77 per cent of the former record production is being accomplished with 27,000 men. Automobile production increased 30 per cent, from 152,647 passenger cars in March to 196,512 in April. This is the largest production since August, 1921, and compares favorably with the record of 220,000 in March, 1920.

The non-ferrous metal industries, emerging from their long period of stagnation, appear to be making a remarkable recovery. The prices for most of these products have finally reached the turning point. Copper has been one of the last of the basic commodities to respond to the tendency toward higher prices. The *Engineering and Mining Journal-Press* average for May was one-half cent above the March and April averages and since the first of April copper has shown a decidedly advancing tendency. The May average for lead of 5.4c. compares with 4.7c. in March and 5.1c. in April. The advance in zinc has been regular and long continued, the upward trend dating from February. Tin has not fluctuated widely, but has been successively stronger during the last 2 months. Quicksilver, antimony and tungsten are also advancing.

In certain of the process industries, however, improvement is inclined to be "spotty." The individual industries are often affected differently by the various economic factors. Thus the coal strike is beginning to be felt in some quarters and it is contended that if the dye industry were not so seriously curtailed because of the inactivity in the textile mills, there might be occasion for some concern re-

garding supplies of the basic coal-tar products. Production in the petroleum industry has been proceeding considerably in excess of domestic consumption and exports. Stocks are piling up and temporarily the industry appears in a weaker statistical position. On the other hand the 10 per cent reduction in freight rates recently authorized by the Interstate Commerce Commission may be looked upon as a strengthening factor in the heavy chemical, fertilizer and other industries which in the past have suffered from excessive transportation charges.

THE FINANCIAL SITUATION

Financially the month of May has been much the same as March and April. The lower money rates and the strengthening economic and industrial situation have added impetus to the unusual activity in the stock market. The advance during May was less spectacular than in the preceding month, but the underlying situation continued strong and practically all of the earlier gains were maintained. The *Wall Street Journal's* average of twenty industrial stocks opened the month at 92.74 and after suffering a very slight reaction during the middle of the month advanced to 96.63 on May 31. CHEM. & MET.'s average of the stock quotations for twenty representative chemical and allied industrials was 63.8 on May 1 and by the end of the month it had shown a gain of 4.4 points.

The effect of easier money rates has already been commented on in these columns. It is of interest to note, however, that on May 19, time money—i.e., fixed date loans—was quoted in New York at the lowest level since August, 1917. Thirty-day loans were negotiated at 3¾ per cent. Call money at that time was available at 3 per cent. The foreign exchange market during May was well sustained, and about the only outstanding feature was the new high levels reached by the pound sterling. On May 1 it was quoted at $4.42¼, on May 5 it had touched $4.44⅜ and on May 18 reached $4.44 7/16. By the end of May it had reached $4.48—the highest point since July 14, 1919.

WHOLESALE PRICES

Commodity prices during May for the most part maintained their earlier gains and showed increased stability. The general index number of the Federal Reserve Board advanced 2 points as compared with the preceding month. The all commodity figure of the Bureau of Labor Statistics remained stationary at 152, but indexes for both chemical and metallurgical products advanced during April. CHEMICAL & METALLURGICAL ENGINEERING'S weighted index of chemical prices averaged 159.32 for the month of May, as compared with 158.04 during April. On May 24 this index had reached 160.49, but later receded somewhat on account of slightly lower prices for such basic chemicals as ammonium sulphate, caustic soda and cottonseed and linseed oils.

THE OUTLOOK

The review of the business situation would not be complete without some discussion of the outlook, particularly in the chemical and related industries. In general it may be safely contended that activity in these industries will continue without major reversals. As the summer season approaches there may be some slackening in the extreme pace set during recent months, but there can be little doubt that genuine improvement in chemical and related industries is scheduled for next fall and winter.

The Beet Sugar Situation

"As a result of the war, the world's beet sugar production, due entirely to shrinkage in Europe, decreased from nearly 9,000,000 long tons in 1912-1913 to 3,500,000 long tons in 1919-1920. This production is again on the up grade, reaching nearly 5,000,000 long tons in 1921-1922. Cane-producing countries, endeavoring to overcome this great falling off, increased their production from 9,250,000 long tons in 1912-1913 to 12,500,000 long tons in 1917-1918, and to 11,500,000 long tons in 1921-1922; this development being largely in Cuba, where the production was increased from 2,500,000 long tons in 1913-1914 to an average of nearly 3,900,000 long tons in the past 3 years.

"Out of the past season's domestic beet sugar production of 20,200,000 bags (900,000 long tons), there remained unsold 5,700,000 bags (250,000 long tons), on March 31, 1922, compared with over 10,000,000 bags (450,000 long tons) a year ago."

The foregoing paragraphs are extracted from the letter by H. Reiman Duval, president of the American Beet Sugar Co., which accompanied the report of that company's operations for the year ended March 31, 1922. The financial statement showed a net loss of $3,134,046, after allowing for taxes, charges and inventory adjustments. Preferred dividends and minor adjustments increased the deficit to $3,455,455. In 1921 the American Beet Sugar Co. reported a net income of $133,509, equal to $2.67 a share on outstanding preferred stock.

President Duval reported that the past year was but a continuation of the "unbroken movement toward normal conditions—a period of falling prices, large losses, liquidations and readjustments." That the future is more promising is shown by the fact that stocks are at a lower level than at any time in recent years and that better financial conditions and increased buying power appear likely to continue throughout the year.

Census of Chemical and Fertilizer Plants

In a special compilation made for the Finance Committee of the Senate, the Bureau of the Census shows that there are 598 establishments in the United States engaged in the manufacture of chemicals. The capital employed is given as $484,488,412. Salary and wage payments total $97,188,958. These establishments pay $28,338,749 in federal taxes and $3,592,640 in state taxes. The value of the products of these factories in 1919 was $438,658,869. The average number of wage earners employed during that year was 55,586. The aggregate horsepower of the plants was 376,940.

There were 600 establishments engaged in the manufacture of fertilizer. Their combined capital was $311,633,259. The total of salary and wage payments was $36,934,732. The value of products in 1919 was $281,143,587. The average number of wage earners was 26,296. The primary power used amounted to 125,939 hp.

The New York Market

NEW YORK, June 5, 1922.

The effects of the holiday interruption and the approaching season of slackened production were somewhat evident in the chemical market during the past week although conditions on the whole were regarded as satisfactory. Apparently the hand-to-mouth buying policies pursued by the consumers and their disinclination to lay in heavy stocks of chemical products indicate that trading this year will be less affected than usual by the summer lull. A surprising number of chemicals formerly regarded as staple commodities and practically always sold on contract between producer and consumer are now figuring actively in the resale and speculative markets.

It is apparent, too, that a number of important price revisions are imminent. Thus in the coal-tar group higher prices are daily expected for benzene, toluene and perhaps other crudes and intermediates. The reason for this is that the coal strike is beginning to pinch in some quarters and is already seriously curtailing byproduct operations. Oxalic acid, notwithstanding its recent upward revision, continues to grow firmer and higher prices are generally demanded. On the other hand, the new prices for ammonium sulphate and nitrate of soda are expected to be considerably lower than the present schedules and the buyers of these commodities naturally prefer to await the official announcement of the producers.

GENERAL AND SPECIAL CHEMICALS

Acetic Acid—The market for the various strengths of acetic acid was considerably easier during the week. Glacial could generally be bought at 8¼@9c. in carlots, but it was evident that in some large sales the former figure was

shaded to 8c. or even less. The 28 per cent strength was available at $2.25 per 100 lb.—a reduction of 10c. from last week's quotations.

Ammonium Sulphate—New prices for this article have not yet been announced, but it is rumored that sales are being made at $3 or less per 100 lb. The open price for f.a.s. material at New York is $3.25.

Barium Chloride—Barium chloride for immediate delivery is quite generally quoted around $100. Imported material to arrive in June and July has been sold at or below $90. Domestic producers report an active demand for their June output at $100.

Caustic Soda—The alkali market continues to maintain its previous strength and the large producers are reporting excellent business. Standard brands of solid caustic are being offered for export at $3.85@$3.90 per 100 lb. f.a.s. New York. Domestic shipments from New York are at $3.75. Contract prices for solid are said to be at 2½c. per lb., basis 60 per cent, works.

Copper Sulphate—This product is extremely scarce and prices are nominally quoted at 6c. per lb. An unprecedented demand from agricultural consumers and the higher prices for the metal are said to be the explanation.

Glycerine—The outstanding incident in this market last week was the announcement that the Japanese Government had placed an order in Great Britain for 250 tons of dynamite glycerine at a figure approximating 14 cents. The domestic market for chemically pure remains unchanged—refiners quoting 14½@15c. in bulk.

Nitrate of Soda—Slightly lower prices prevail for spot material, with goods for future delivery offered at $2.25@$2.60. Large shipments have recently been received and the market is apparently well supplied. The price agreement between producers is soon to expire and lower prices are expected.

Oxalic Acid—A further advance in this acid brings the price up to 14@14½c. for carlots at works. A noticeable scarcity of spot material has resulted in 15c. being demanded by first hands.

Prussiate of Soda—With the exception of a 10-ton lot on Saturday, but very small quantities of this material have reached the New York market and prices have varied over a wide range. Some sales early in the week were reported as low as 21c., but in general 23@25c. was asked for spot goods. Shipment material was quoted at 20½c.

Sal Ammoniac—The gray, granular material was obtainable from the domestic producers at slightly lower figures. Their price for carlots was 7½@8c. The imported sal ammoniac was selling at 7@7½c.

Sodium Acetate—One large manufacturer was asking 5½@6½c. for carlots, but in other quarters this commodity was still available at its former price, 5@5½c.

Coal-Tar Products

Aniline Oil—Some sales are reported at less than the manufacturers' quotation of 15@16c.

Benzene—An upward revision of benzene prices is considered likely, due pricipally to the curtailed production caused by the coal strike.

Beta-Naphthol—The market for this commodity has been unsteady and generally weaker. A number of producers quote 23c., where 25c. was the predominating figure a week ago.

Naphthalene—Considering the season, business in naphthalene may be regarded as fair. Some lower prices were obtainable, though generally from dealers rather than manufacturers.

Phenol—The scarcity of this product has strengthened its price considerably and the U.S.P. grade is quoted nominally at 14@15c., with the latter figure the more prevalent.

Linseed Oil and Naval Stores

Linseed Oil—Coincident with the lower flaxseed prices this oil has suffered another decline and it is generally reported that 82@83c. per gal. for carlots is the prevailing price. The immediate future is not certain, but many are inclined to think that a return to prices of a few months ago is easily possible. On the other hand, an early enactment of the new tariff will tend to sustain present high prices. Imported oil is offered at 77@78c., duty paid, for June arrival.

Turpentine—Market somewhat easier and prices are declining slightly.

Rosin—The advances predicted in these columns last week have resulted in the following prices per barrel of 280 lb., ex-yard: B, $5.45; D, $5.70; E, $5.90; F, $6.10; G, $6.15; H, $6.20; I, $6.20; K, $6.40; M, $6.70; N, $6.90, W.G., $7.75 and W.W., $8.25.

The Chicago Market

Chicago, Ill., June 1, 1922.

The general tone of the industrial chemical market in this section is firmer. Imported chemicals in particular are very firm and price advances are numerous. It was generally reported that while stocks were sufficient for present needs any unusual demand would cause a shortage. Consumers are beginning to show more confidence in the market and in some quarters business could almost be called brisk.

Industrial Chemicals

Spot stocks of the alkalis are reported to be only moderate and the tone of the market is slightly firmer. Small or moderate lots of *caustic soda* are available at $3.85@$3.95 per 100 lb. for the solid and $4.35@$4.50 for the ground. *Caustic potash*, while unchanged as to price, is exceptionally firm, and imported 88-92 per cent material cannot be located under 6½c. *Soda ash* is reported to be moving well at $2.20@$2.30 per 100 lb. for 58 per cent material in cooperage.

Alums are moving only in a routine way and are unchanged as to price. *Potash alum* is available at 4½c. per lb. for the lumps and 5½c. for the powdered. *Barium chloride* is exceedingly scarce and only a few scattered lots are available at $120@$130 per ton. Owing to the strength of the metal, *copper sulphate* has been advanced to 6c. per lb. by the leading factors. A good movement is reported at this new figure. *Sal ammoniac* is in fair request and the white granular is offered at 7½@7¾c. per lb., the higher figure representing the prevailing price for domestic goods. A slightly better demand is to be noted for *carbon tetrachloride* and resale material in large drums is quoted at 10@10½c. per lb. No change is announced in the price of *furfural*, which is available at 50c. per lb. *Formaldehyde* continues dull and easy at 10c. per lb. for single barrels. This price can easily be shaded with a firm order. *White arsenic* is firm at 8@8½c. per lb. for small or medium quantities. *Glycerine* is exceptionally dull and supplies of the c.p. material can be bought at 14c. per lb., bulk basis.

Bichromates are in an easy position but are unchanged as to price. *Potassium bichromate* is offered at 11½c. per lb. in single cask lots and the soda in similar quantities at 9@9½c. *Potassium permanganate* is dull and easy, with holders of spot goods asking 16c. for the U.S.P. crystals. Cabled quotations from abroad are slightly lower, which had a disturbing effect on the market. The prussiates are probably the firmest items on the list, the firmness no doubt due to the increasing scarcity of supplies both here and abroad. Practically nothing can be had from abroad for immediate delivery and only small quantities are available for the future. *Red prussiate of potash* is still off of the market and the yellow is very scarce at 34@36c. per lb. *Hyposulphite of soda* continues to move in a routine way at $3.85 per 100 lb. for pea crystals in barrels.

Linseed Oil and Naval Stores

Lower prices on *linseed oil* are predicted by a leading factor; however, the movement to the consuming trade continues very good. Boiled oil today is quoted in 5-bbl. lots at 93c. per gal, with the usual 2c. reduction on the raw.

Turpentine is scarce and the movement very good. The tendency of this material is toward higher prices, which is no doubt stimulating sales to a certain extent. Today's price on 5-bbl. lots is $1.05 per gal. *Rosins* are reported to be getting firmer every day, with a good movement. The WG grade is quoted today in less than carlots at $8.75 per 280 lb.

The Iron and Steel Market

PITTSBURGH, June 2, 1922.

The steel market has become quieter still. There is a fair volume of activity in the aggregate, but the turnover is much lighter than in February, March and April. Buying of steel at present is chiefly against newly developed requirements, the regular buyers, jobbers and manufacturing consumers being on the whole well covered for some time to come. Freight-car buying has perhaps been at a slightly lower rate in the past week or two. The automobile trade does not appear to be buying much steel at the moment, although the production of cars is substantially at record rate. Lettings of fabricated steel contracts represented 77 per cent of the shop capacity in March and 99 per cent in April, the high month since July, 1918, but May lettings are now estimated at only about 66 per cent. In fact, there is no important line of steel consumption outside of the automobile trade that presents the appearance today of using as much steel as it did in 1912 and 1913, yet the production of steel is at a rate 25 per cent greater than in those years.

The change in the market situation in the past fortnight, whereby there is less search by buyers for early delivery material, is probably attributable not to decreases in buyers' actual requirements but to a change in buyers' appraisals of the prospects of steel production, there being less fear that the steel mills will be unable, on account of the coal strike, to maintain their operations. Certainly the record of the first two months of the coal strike is impressive, for the mills have increased their production in this time. Last December steel ingots were produced at an annual rate slightly under 20,000,000 tons. By April 1 the rate had risen to about 35,000,000 tons. The rate today is about 38,000,000 tons, and the average rate since April 1 has probably been all of 37,000,000 tons. This means production of finished rolled steel at the rate of 2,600,000 net tons a month in the past two months. Besides this amount of steel, the tonnage assigned to any one line of consumption seems small, hence most experienced observers have doubts whether all the steel shipped is actually passing into ultimate consumption.

STEEL PRICES

Steel prices are firm all along the line, as follows: Bars, shapes and plates, 1.60c.; blue annealed sheets, 3.40c.; black sheets, 3.15c.; galvanized sheets, 4.15c.; hoops, bands and hot rolled strips; 2.25c.; standard steel pipe, 71 per cent basing discount; plain wire, 2.25c.; tin plate, $4.75. Nails are held at $2.40 by the leading interest and at $2.50 by the independents. The fact that the leading interest has failed to make an advance in nails, in the circumstances, may be regarded as significant of Steel Corporation's general policy. In most of the lines named some independent producers are quoting higher prices, and are probably securing them on small tonnages for early deliveries, but on the whole the volume of such business is hardly sufficient to suggest that the market is likely to reach higher levels.

A decision as to freight rates on iron ore from Lake Superior mines to lake is momentarily expected, the prospect being that there will be a reduction of 25 cents, making the rate from the Mesabi range 75 cents. Season prices for Lake Superior ore will then be developed, and will likely represent a reduction of at least 50 cents from the 1921 schedule, when Mesabi non-bessemer was $5.55 f.o.b. Lake Erie dock. A 50-cent reduction would include the 25 cents mentioned, a 10-cent reduction in the vessel rate, and a 15-cent concession by the ore producers themselves. The general rate reduction ordered last week by the Interstate Commerce Commission will apply to iron ore from Lake Erie docks to furnaces, and to coal, coke, limestone, pig iron, scrap and other rates generally, averaging a 10 per cent reduction. With the prospective reduction in Lake Superior iron ore the average cost of making pig iron at Northern furnaces will decline, say, $1.25 or $1.50 per ton, and the reduction in the cost of making steel will be about the same amount. As pig iron and steel prices are subject to so many influences, a decrease of this amount in cost would hardly be identified in market prices. The part of blast-furnace cost attributable to ore is largely theoretical, as the furnaces still have large piles of ore.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	..... –	$0.38 – $0.40
Acetone	lb.	$0.08 – $0.09	.09½ – .10
Acid, acetic, 28 per cent	100 lbs.	2.25 – 2.50	2.55 – 3.00
Acetic, 56 per cent	100 lbs.	5.00 – 5.25	5.30 – 5.50
Acetic, glacial, 99½ per cent, carboys, 100 lbs.		8.50 – 9.00	9.50 – 9.75
Boric, crystals	lb.	.11 – .11½	.11½ – .12
Boric, powder	lb.	.11 – .11½	.11½ – .12½
Citric	lb.	..... –	.45 – .46
Hydrochloric	100 lb.	1.10 – 1.20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11 – .12
Lactic, 44 per cent tech	lb.	.09½ – .10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04 – .04½	.04½ – .05
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)		..... –	..... – .....
Nitric, 40 deg.	lb.	.06 – .06½	.06½ – .07
Nitric, 42 deg.	lb.	.06½ – .06¾	.07 – .07½
Oxalic, crystals	lb.	.14 – .14½	.14½ – .15
Phosphoric, 50 per cent solution	lb.	.08 – .08½	.08½ – .09½
Picric	lb.	.22 – .24	.24½ – .30
Pyrogallic, resublimed	lb.	..... –	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	10.00 – 11.00	..... – .....
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	..... – .....
Sulphuric, 66 deg., tank cars	ton	15.00 – 16.00	..... – .....
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.50 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	..... –	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	..... –	.28 – .29
Tartaric acid, imported, powdered	lb.	..... –	.28½ – .30
Tartaric acid, domestic	lb.	..... –	..... – .30
Tungstic, per lb. of WO	lb.	..... –	1.00 – 1.10
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4.95
Alcohol, methyl (see methanol)		..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.30 – .32
Alcohol, denatured, 188 proof No. 5	gal.	..... –	.30 – .32
Alum, ammonia, lump	lb.	.03½ – .03¾	.04 – .04½
Alum, potash, lump	lb.	.03½ – .04	.04½ – .05
Alum, chrome lump	lb.	.07½ – .08	.08½ – .08¾
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03¾
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.07½ – .07¾	.08 – .08¾
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.07 – .07½	.07½ – .08
Ammonium nitrate	lb.	.06 – .06½	.06½ – .07½
Amylacetate tech.	gal.	..... –	2.00 – 2.25
Arsenic, white, powdered	lb.	.07½ – .07¾	.07½ – .08
Arsenic, red, powdered	lb.	.12 – .12½	.12½ – .13
Barium chloride	ton	100.00 – 105.00	107.00 – 110.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21½ – .22
Barium nitrate	lb.	.06½ – .07	.07½ – .08
Barium sulphate (precip.) (blanc fixe)	lb.	.03½ – 0	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04¾	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	1.60 – 1.75	1.80 – 2.75
Blue vitriol (see copper sulphate)		..... –	..... – .....
Borax	lb.	.05½ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)		..... –	..... – .....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lbs.	1.75 – 2.00	..... – .....
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	24.00 – 24.50	24.75 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02½
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.79 – .83
Carbon bisulphide	lb.	.06½ – .06¾	.07 – .07½
Carbon tetrachloride, drums	lb.	.09½ – .10	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)		..... –	..... – .....
Caustic soda (see sodium hydroxide)		..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04½ – .04¾	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04½ – .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05½ – .06
Chloroform	lb.	..... –	.30 – .32
Cobalt oxide	lb.	..... –	2.00 – 2.10
Copperas	ton	20.00 – 22.00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.19 – .20	.20½ – .21
Copper cyanide	lb.	..... –	.58 – .60
Copper sulphate, crystals	100 lb.	6.00 – 6.15	6.25 – 6.50
Cream of tartar	lb.	..... –	.25 – .26
Epsom salt (see magnesium sulphate)		..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.60 – .65
Ethyl acetate, pure (acetic ether, 90% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	.08½ – .08¾	.09 – .09½
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	..... – .....
Fullers earth—imported powdered—net	ton	30.00 – 32.00	..... – .....
Fusel oil, ref.	gal.	..... –	2.15 – 2.50
Fusel oil, crude	gal.	..... –	1.30 – 1.50
Glauber's salt (see sodium sulphate)		..... –	..... – .....
Glycerine, c. p. drums extra	lb.	..... –	.15 – .15½
Iodine, resublimed	lb.	..... –	4.20 – 4.25
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate	lb.	..... –	.09½ – .12
Lead arsenate, powd.	lb.	.14 – .14½	.14½ – .15½
Lead nitrate	lb.	..... –	.15 – .20
Litharge	lb.	.07½ – .08	.08½ – .09
Magnesium carbonate, technical	lb.	.08½ – .08¾	.09 – .09½
Magnesium sulphate, U. S. P.	100 lb.	2.50 – 2.60	2.65 – 2.85
Magnesium sulphate, technical	100 lb.	..... –	1.00 – 1.80
Methanol, 95%	gal.	..... –	.57 – .58
Methanol, 97%	gal.	..... –	.59 – .60
Nickel salt, double	lb.	..... –	.11 – .11½
Nickel salt, single	lb.	..... –	.11 – .11½
Phosgene (see carbol chloride)		..... –	..... – .....
Phosphorus, red	lb.	.45 – .46	.47 – .50
Phosphorus, yellow	lb.	..... –	.30 – .35

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Potassium bichromate	lb.	.09½ – .10	.10½ – .10
Potassium bromide, granular	lb.	..... –	.17 – .20½
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80–85%	lb.	.05 – .05½	.06 – .06½
Potassium chlorate, powdered and crystals	lb.	.06½ – .07	.07½ – .08
Potassium cyanide	lb.	..... –	.45 – .50
Potassium hydroxide (caustic potash)	100 lb.	5.75 – 6.00	6.25 – 6.75
Potassium iodide	lb.	..... –	3.30 – 3.40
Potassium nitrate	lb.	.07½ – .07½	.08 – .09
Potassium permanganate	lb.	.14 – .14½	.14½ – .20
Potassium prussiate, red	lb.	nominal	nominal
Potassium prussiate, yellow	lb.	.32 – .32½	.32½ – .33
Rochelle salts (see sodium potas. tartrate)		..... –	..... – .....
Salammoniac, white, granular	lb.	.07 – .07½	.07½ – .08
Salammoniac, gray, granular	lb.	.07½ – .07½	.07½ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	20.00 – 25.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.65 – 1.70	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.90 – 2.00	2.10 – 2.50
Soda ash, dense	100 lb.	1.95 – 2.05	2.10 – 2.60
Sodium acetate	lb.	.05 – .05½	.05½ – .06
Sodium bicarbonate	100 lb.	1.80 – 1.90	1.95 – 2.40
Sodium bichromate	lb.	.07½ – .07½	.07½ – .08
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½ – .04½	.04½ – .05½
Sodium chlorate	lb.	.06 – .06½	.06½ – .07
Sodium chloride	long ton	12.00 – 13.00	..... – .....
Sodium cyanide	lb.	.22 – .23	.23½ – .25
Sodium fluoride	lb.	.09 – .09½	.09½ – .10
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.50	3.80 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.85 – 3.90	3.95 – 4.25
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.85 – 4.00	4.30 – 4.50
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.03 – .03½	.03½ – .04
Sodium nitrite	lb.	.08½ – .09	.09½ – .09½
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04½ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.25 – .25½	.25½ – .25½
Sodium silicate, solution (40 deg.)	100 lb.	.85 – 1.00	1.05 – 1.25
Sodium silicate, solution (60 deg.)	100 lb.	2.35 – 2.50	2.55 – 2.90
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.95 – 1.05	1.15 – 1.50
Sodium sulphide, fused, 60–62 per cent (conc.)	lb.	.03½ – .04½	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03½	.03½ – .04½
Strontium nitrate, powdered	lb.	.09½ – .10	.10½ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05½ – .06
Sulphur, crude	ton	18.00 – 20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	..... –	2.00 – 2.75
Talc—imported	ton	30.00 – 40.00	..... – .....
Talc—domestic powdered	ton	18.00 – 25.00	..... – .....
Tin bichloride	lb.	.09 – .09½	.09½ – .10
Tin oxide	lb.	..... –	.35 – .37
Zinc carbonate	lb.	.14 – .14½	.14½ – .15½
Zinc chloride, gran.	lb.	.06 – .06½	.06½ – .08
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08½ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$1.00 — $1.05
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.30 — .31
Aniline oil, drums extra	lb.	.15 — .16
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.25 — 1.30
Benzene, pure, water-white, in drums (100 gal.)	gal.	.29 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.27 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.75 — .85
Benzoic acid, U.S.P.	lb.	.60 — .65
Benzoate of soda, U.S.P.	lb.	.50 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.23 — .26
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbasol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97–99%, straw color, in drums	gal.	.53 — .55
Cresylic acid, 95-97%, dark, in drums	gal.	.48 — .50
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.65 — .70
Dimethylaniline	lb.	.36 — .38
Dinitrobenzene	lb.	.22 — .25
Dinitroclorbenzene	lb.	.22 — .24
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.33 — .35
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.24 — .26
Diphenylamine	lb.	.59 — .65
H-acid	lb.	.85 — 1.00
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.09 — .11
Monoethylaniline	lb.	1.05 — 1.25
Naphthalene crushed, in bbls.	lb.	.06 — .06½
Naphthalene, flake	lb.	.06½ — .07
Naphthalene, balls	lb.	.08 — .08
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	.15 — .17
Ortho-amidophenol	lb.	.40 — 2.50
Ortho-dichlor-benzene	lb.	2.15 — .20
Ortho-nitro-phenol	lb.	.70 — .75
Ortho-nitro-toluene	lb.	$0.10 — $0.13
Ortho-toluidine	lb.	.14 — .18
Para-amidophenol, base	lb.	1.25 — 1.30
Para-amidophenol, HCl	lb.	1.30 — 1.35
Para-dichlorbenzene	lb.	.13 — 16
Paranitroaniline	lb.	.75 — .77
Para-nitrotoluene	lb.	.55 — .65
Para-phenylenediamine	lb.	1.55 — 1.60
Para-toluidine	lb.	.90 — 1.00
Phthalic anhydride	lb.	.35 — .38
Phenol, U. S. P., drums	lb.	.14 — 15
Pyridine	gal.	1.75 — 2.75
Resorcinol, technical	lb.	1.30 — 1.35
Resorcinol, pure	lb.	1.75 — 1.80
Salicylic acid, tech., in bbls.	lb.	.25 — .25½
Salicylic acid, U. S. P.	lb.	.26 — .26½
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.25 — .28
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.10 — .12
Sulphanilic acid, crude	lb.	.24 — .26
Tolidine	lb.	1.20 — 1.30
Toluidine, mixed	lb.	.30 — .35
Toluene, in tank cars	gal.	.25 — 28
Toluene, in drums	gal.	.30 — .35
Xylidines, drums, 100 gal.	lb.	.40 — .45
Xylene, pure, in drums	gal.	.40 — .45
Xylene, pure, in tank cars	gal.	.45 — .....
Xylene, commercial, in drums, 100 gal.	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 — .....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.20 — $0.21
Beeswax, refined, dark	lb.	.26 — .28
Beeswax, refined, light	lb.	.30 — .32
Beeswax, white pure	lb.	.35 — .40
Candelilla, wax	lb.	.35 — .36
Carnauba, No. 1	lb.	.45 — .46
Carnauba No. 2, North Country	lb.	.25 — .25½
Carnauba, No. 3, North Country	lb.	.16 — .16½
Japan	lb.	.16½ — .17
Montan, crude	lb.	.04 — .04½
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04½ — .....
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½ — .....
Paraffine waxes, refined, 118-120 m.p.	lb.	.02½ — .03
Paraffine waxes, refined, 125 m.p.	lb.	.03 — .03½
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 — .04½
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ — .04½
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 — .05½
Stearic acid, single pressed	lb.	.09 — .09½
Stearic acid, double pressed	lb.	.09½ — .09½
Stearic acid, triple pressed	lb.	.10½ — .10½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	$5.45	— $5.70
Rosin E-I	280 lb.	5.90	— 6.10
Rosin K-N	280 lb.	6.40	— 6.90
Rosin W. G.-W. W.	280 lb.	7.75	— 8.25
Wood rosin, bbl.	280 lb.	6.25	— .....
Spirits of turpentine	gal.	.96	— 96½
Wood turpentine, steam dist	gal.	.85	— .....
Wood turpentine, dest. dist.	gal.	.70	— .70
Pine tar pitch, bbl	200 lb.	.....	— 6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	.....	— 9.50
Retort tar, bbl.	500 lb.		— 9.00
Rosin oil, first run	gal.	.36	— .....
Rosin oil, second run	gal.	.38	— .....
Rosin oil, third run	gal.	.46	— .....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.10
Pine oil, pure, dest. dist.	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref.	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N.Y.	100 lb.	3.25	— 3.40
Blood, dried, f.o.b., N. Y.	unit	3.55	— 3.65
Bone, 3 and 50, ground, raw	ton	27.00	— 28.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10	— 3.20
Nitrate of soda	100 lb.	2.65	— 2.80
Tankage, high grade, f.o.b. Chicago	unit	3.00	— 3.10
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50	— 3.75
Tennessee, 78-80%	ton	7.00	— 7.50
Potassium muriate, 80%	ton	33.50	— 35.00
Potassium sulphate	unit	1.00	— .....

Crude Rubber

Para—Upriver fine	lb.	$0.18	— 1°½
Upriver coarse	lb.	.13	—
Upriver caucho ball	lb.	.13	— .13½
Plantation—First latex crepe	lb.	.17½	— .1 ½
Ribbed smoked sheets	lb.	.15½	— .1 ½
Brown crepe, thin, clean	lb.	.14	— .....
Amber crepe No. 1	lb.	.14½	— .....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.11	— $0.11½
Castor oil, AA, in bbls.	lb.	.12	— .12½
China wood oil, in bbls.	lb.	.13½	— .17
Coconut oil, Ceylon grade, in bbls.	lb.	.08½	— .09
Coconut oil, Cochin grade, in bbls.	lb.	.09½	— .09½
Corn oil, crude, in bbls.	lb.	.11½	— .11½

Cottonseed oil, crude (f. o. b. mill)	lb.	$0.10 —	$0.10½
Cottonseed oil, summer yellow	lb.	.12 —	.12½
Cottonseed oil, winter yellow	lb.	.13 —	.13½
Linseed oil, raw, car lots (domestic)	gal.	.85 —	.86
Linseed oil, raw, tank cars (domestic)	gal.	.82 —	.83
Linseed oil, in 5-bbl lots (domestic)	gal.	.89 —	.90
Olive oil, denatured	gal.	1.15 —	1.17½
Palm, Lagos	lb.	.07½ —	.07¾
Palm, Niger	lb.	.06½ —	.06¾
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.10 —	.10
Peanut oil, refined, in bbls	lb.	.12¾ —	.13
Rapeseed oil, refined in bbls	gal.	.83 —	.84
Rapeseed oil, blown, in bbls	gal.	.85 —	.86
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11¾ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.10 —	....

FISH

Light pressed menhaden	gal.	$0.54 —	. ..
Yellow bleached menhaden	gal.	.57 —	....
White bleached menhaden	gal.	.56 —	....
Blown menhaden	gal.	.61 —	....

Miscellaneous Materials

All f.o.b. New York, Unless Otherwise Stated

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$900 00	$1200.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	90 00	—125.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	22.00	— 28.00
Barytes, ground, white, f.o.b. mills	net ton	17.00	— 23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00	— 21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00	— 24 00
Barytes, crude f.o.b. mines	net ton	8.00	— 9.00
Casein	lb.	.14	— .15
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00	— 8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00	— 9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00	— 20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00	— 12.00
China clay (kaoli n)ground, f.o.b. Virginia points	net ton	15.00	— 20.00
China clay (kaolin), imported, lump	net ton	14.00	— 20.00
China clay (kaolin), imported, powdered	net ton	30.00	— 35.00
Feldspar, No. 1 pottery grade	long ton	6.40	— 6.75
Feldspar, No. 2 pottery grade	long ton	5.75	— 5.90
Feldspar, No. 1 soap grade	long ton	7.00	— 7.50
Feldspar, No. 1 Canadian, for mill	long ton	21.00	— 22.00
Graphite, Ceylon lump, first quality	lb.	.06	— .07
Graphite, Ceylon chip	lb.	.04½	— .05½
Graphite, high grade amorphous crude	ton	15.00	— 30.00
Kieselguhr, f.o.b. mines, Cal	per ton	40.00	— ....
Kieselguhr, f.o.b. N. Y	per ton	55.00	— 60.00
Magnesite, calcined (crude)	per ton	8.00	— 12.00
Pumice stone, imported	lb.	.03	— .05
Pumice stone, domestic, lump	lb.	.05	— .05½
Pumice stone, domestic, ground	lb.	.06	— .07
Shellac, orange fine	lb.	.81	— .82
Shellac, orange superfine	lb.	.84	— ....
Shellac, A. C. garnet	lb.	.62	— .63
Shellac, T. N.	lb.	.80	— ....
Silica, glass sand, f.o.b. Indiana	per ton	1.25	— 2.25
Silica, sand blast material, f.o.b. Indiana	per ton	2.25	— 4.50
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	16 00	— 16.00
Silica, building sand, f.o b. Pa	per ton	2 00	— 2.75
Soapstone	ton	12.00	— 15.00
Tale, 200 mesh, f.o.b. Vermont	ton	7.00	— 12.00
Tale, 200 mesh, f.o.b. Georgia	ton	7.50	— 12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	16.00	— .0.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	per 1,000	$130.00
Chrome brick, f.o.b. Eastern shipping points	net ton	40–42
Chrome cement, 40-50% Cr_2O_3	net ton	23.00
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	28–35
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	26–28
Magnesite brick, 9-in. straight (f.o b. works)	net ton	53
Magnesite brick, 9-in. arches, wedges and keys	net ton	70
Magnesite brick, soaps and splits	net ton	90
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	30–32
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	33–35
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000	27–30
Silicon carbide refractory brick, 9-in.	1,000	1100.00

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.11 —	....
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.12 —	....
Ferromanganese, 78-82% Mn, domestic	gross ton	67.00 —	69.00
Spiegeleisen, 19-21% Mn	gross ton	36.00 —	....
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2 25
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	56 00 —	58.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.45 —	.50
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	.....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.00 —	3.50

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried	net ton	$6.00 —	$12.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	19.00 —	20.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	19 00 —	20.00
Coke, foundry, f.o.b. ovens	net ton	6.75 —	7.00
Coke, furnace, f.o.b. ovens	net ton	6.25 —	6.50
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	17.50 —	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	20.00 —	22 00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.26½ —	.27
Manganese ore, chemical (MnO_2)	net ton	60.00 —	65.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.50 —	.....
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00 —	.....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½ —	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	13½
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	.....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	2.50 —	2.75
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C	unit	2.75 —	3.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	.....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13½

Non-Ferrous Metals

New York Markets

	Cents per Lb
Copper, electrolytic	13.625
Aluminum, 98 to 99 per cent	19.00–20.00
Antimony, wholesale lots, Chinese and Japanese	5.40–5 50
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	29.00–32.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	31.75
Lead, New York, spot	5.65–5.75
Lead, E. St. Louis, spot	5.50
Zinc, spot, New York	5.75
Zinc, spot, E. St. Louis	5.25–5.30

OTHER METALS

Silver (commercial)	oz.	$0.72½
Cadmium	lb.	1.15–1.20
Bismuth (500 lb. lots)	lb.	2.00@2.10
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.10
Platinum	oz.	85.00@87.50
Iridium	oz.	150.00@175.00
Palladium	oz.	55.00
Mercury	75 lb.	55.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.25
Copper bottoms	27.75
Copper rods	19.25
High brass wire	16.75
High brass rods	14.25
Low brass	18.25
Low brass rods	18.75
Brazed brass	23.00
Brazed bronze	28.00
Seamless copper	20.75
Seamless high brass	18.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	10.25@10.50
Copper, heavy and wire	10.00@10.25
Copper, light and bottoms	7.75@ 8.25
Lead, heavy	3.90@ 4.15
Lead, tea	2½–2
Brass, heavy	4.50@ 4.75
Brass, light	4.00@ 4.25
No. 1 yellow brass turnings	4.00@ 4.25
Zinc	2.00@ 2.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$2.48	$2.48
Soft steel bars	2.38	2.38
Soft steel bar shapes	2.38	2.38
Soft steel bands	2.98	2.98
Plates, ¼ to 1 in. thick	2.48	2.48

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Arkansas

TEXARKANA—The plant of the Liberty Cotton Oil Co., Rose Hill, has been acquired by new interests, headed by N. P. Sanderson. A company is being organized to operate the property, and preliminary plans are being considered for extensions and improvements. Work will be commenced at an early date.

California

RICHMOND—The Pacific Sanitary Mfg. Co., recently organized with a capital of $2,000,000, will take over and operate three existing plants in this vicinity, heretofore controlled by officials of the new organization. These plants comprise an enameled-iron works at North Richmond, and two potteries on Barrett Ave., San Pablo. Plans are under way for extensive additions and improvements in all three plants, to increase the capacity approximately 100 per cent. N. W. Stern is president, and M. E. and E. S. Wangenheim, first and second vice-presidents, respectively.

OXNARD—The Associated Oil Co. has plans under way for additions and improvements in its local distributing plant to cost about $50,000.

COALINGA—The Continental Petroleum Refining Co. is planning for the construction of a series of new distributing plants in the San Joaquin Valley section. Property has been acquired at Hanford and Tulare, and the first plants will be located here. Other sites will be purchased at an early date.

Georgia

DUBLIN—The Southern Mfg. Co. will soon commence the construction of a new local plant for the manufacture of paints, varnishes, etc. A list of equipment is being arranged for installation, to include grinders, chasers, etc. L. H. Harville is general manager.

Illinois

MATTESON—The K. I. Herman Chemical Corp., 332 South Michigan Ave., Chicago, has commenced the construction of its proposed local plant, 3-story and basement, 60x140 ft., estimated to cost approximately $300,000. The general contract has been awarded to the Chicago Heights Construction Co., Chicago Heights. Harvey C. Miller, 112 West Adams St., Chicago, is architect. K. I. Herman is head.

CHICAGO—The Western Foundry Co., 3634 South Kedzie Ave., manufacturer of small gray iron and other metal castings, has filed plans for the construction of a 1-story plant addition, 76x138 ft., to cost about $15,000, exclusive of equipment. Frank D. Chase, Inc., 645 North Michigan Ave., is architect.

Louisiana

MONROE—The Atlas Oil Co. will commence the immediate construction of a new carbon mill and gasoline extraction plant in the Ouachita Parish district. The initial works, with equipment, will cost in excess of $200,000.

HOMER—The Atlantic Oil & Refining Co., Shreveport, has acquired the local property of the Gilliland Co., as well as holdings and plant of the same company at Haynesville, from P. J. Hurley and George O. Baird, receivers. A consideration said to be $3,300,000, was given for the property, and the new owner has tentative plans under way for a number of additions and improvements.

Maryland

BALTIMORE—The Pyrocolor Corp., 503 East 88th St., New York, N. Y., manufacturer of special composition indestructible signs and kindred specialties, has tentative plans under consideration for the construction of a new local plant, and is in negotiation for the purchase of a suitable site. The Industrial Bureau of the Merchants' and Manufacturers' Association, Baltimore, is interested. Lawrence L. Stevens is engineer in charge.

Massachusetts

CHELSEA—The United Indigo & Chemical Co., Ltd., 176 Federal St., Boston, has work under way on an addition to its plant at 960 Broadway, to be 40x60 ft.

Michigan

IONIA—The Michigan Porcelain Tile Co. has awarded a contract to Glenn Pierce, Ionia, for the erection of a new 1-story and basement plant, 120x160 ft., to cost about $40,000, for the manufacture of tile and other burned clay products. Harry E. Kidder is general manager.

Missouri

ANNAPOLIS—The Annapolis Lead Co., 1217 International Life Bldg., St. Louis, has awarded a general contract to Stupp Bros., St. Louis, for the erection of its proposed new local plant, consisting of a crusher and concentrating building, power house and other structures. The plant will have an initial capacity of about 1,000 tons, and will cost approximately $400,000, including machinery. M. C. Rhodes is president.

KANSAS CITY—The Rubber Mfg. Co. is planning for enlargements in its plant, comprising the former works of the Rubber Products Co., recently acquired. It is purposed to increase the capacity to 1,000 tires and tubes per day.

New Jersey

NUTLEY—George LaMonte & Son, Kingsland Rd., manufacturer of paper products, have awarded a contract to Henry Doremus, 36 Orange St., Newark, for the construction of a 1-story plant addition, 60x80 ft. Fletcher-Thompson, Inc., Fairfield Ave., Bridgeport, Conn., is engineer.

YARDVILLE—A new company is being organized under the direction of Edward D. Newman, 29 Broadway, New York, N. Y., to operate the plant of the Zee Zee Rubber Co., recently acquired from the receiver, Henry Klag, Jr., for a consideration of $58,000. The works will be used for the manufacture of automobile tires and tubes, and a number of improvements will be made. The plant comprises two main 1-story buildings, 50x90 ft. and 40x90 ft., respectively, on a 3½-acre site.

NEWARK—The Federal Button Co., New Jersey Railroad Ave. and Market St., manufacturer of composition products, has plans under way for the construction of a 4-story addition to its plant at Wright and Emmett Sts., comprising the former works of the Klaxon Co., and recently acquired. Present buildings will also be remodeled and improved. The work, including machinery installation, is estimated to cost close to $300,000. S. Mendel is president; and Edward J. Duggan, secretary and treasurer.

DELAIR—The Kieckhefer Paper Co., Camden, manufacturer of paper products, has let a contract to Erwin & Leighton, 126 North 12th St., Philadelphia, Pa., for the construction of a new plant on the river front at Delair, N. J. The company is a subsidiary of the Kieckhefer Box Co., Milwaukee, Wis. J. W. Kieckhefer is president.

New York

ONEIDA—The Mohawk Asbestos Slate Co., Madison Ave., has tentative plans under way for the construction of an addition to its plant.

NORTH TONAWANDA—The Frontier Mfg. Co., Erie Ave., is considering plans for the rebuilding of the portion of its oil-manufacturing plant, destroyed by fire, May 23, with loss reported at about $22,000.

BROOKLYN—The Hugo Brand Leather Co., 178 William St., New York, has acquired the 2- and 3-story buildings, on site 71x100 ft., on 13th St. near 3rd Ave., South Brooklyn, for a new plant. The property heretofore has been held by the Charles A. Schieren Co., manufacturer of similar leather products.

BUFFALO—The Department of Public Works will take bids until July 11 for the construction of its proposed new filtration plant at the city water works, estimated to cost in excess of $3,500,000, including equipment. George G. Andrews, City Hall, is water commissioner. Plans will be available about June 11.

Oklahoma

WAYNOKA—The Santa Fe Salt Co. has plans under way for the construction of a new plant with initial output of about 200 tons of salt per day. The company has extensive salt deposits in Woods County, where the plant will be located. P. L. Clifton, Pomeroy, O., is president and manager; C. T. Cavan, Waynoka, is consulting engineer.

ALLEN—The Pacific Petroleum Co., Tulsa, has leased the local oil refinery of the Crystal White Refining Co., and in the future will operate the plant. It is proposed to develop at once a capacity for handling about 1,000 bbl. of crude oil a day. R. A. Irwin is general manager.

Pennsylvania

PHILADELPHIA—The Gill Glass Co., Inc., Amber and Venango Sts., will break ground at once for the construction of a 2-story addition, 85x120 ft., estimated to cost about $42,000. The general building contract has been let to William R. Dougherty, 1608 Sansom St. Francis D. Gill is president.

LIMERICK—The Vulcweld Rubber Co., Pottstown, has preliminary plans under way for the construction of a new local plant on property recently acquired, about 300x400 ft., to be equipped for the manufacture of automobile tires and other rubber products.

PHILADELPHIA—The Griburn Co. has leased a portion of the building at 721-23 Cherry St., for a new plant for the manufacture of lubricating oil products.

Texas

MINERAL WELLS—The Great Texas Oil & Refining Co., Fort Worth, has preliminary plans under way for the erection of a new local refinery with initial output of about 1,000 bbl. a day. The company is now operating plants at Breckenridge and De Leon, and is capitalized at $2,000,000. F. O. Stevenson is consulting engineer.

BRECKENRIDGE—The Hurley Gas Co. will soon commence the construction of a new gasoline extraction plant, on site about 2 miles from the city. It will be equipped for a capacity of about 6,000 gal. per day, with facilities for handling approximately 15,000,000 cu.ft. of gas daily. W. P. Dykemann and H. P. Lyons are in charge.

WICHITA FALLS—The City Council is planning for the immediate installation of a new filtration plant at the municipal waterworks. It is estimated to cost close to $25,000.

Virginia

GOSHEN—The N. Q. Speer Co. has plans under way for the installation of a new local plant for the production of glass sand, with estimated cost reported at about $30,000.

GLOUCESTER—The Roaring Springs Marl Lime Co. is planning for the immediate development of a tract of lime property, totaling about 10 acres, and will install machinery for an output of about 50 tons a day. A complete lime producing plant is contemplated. R. M. Janney heads the company.

NORFOLK—The City Gas Co. will make extensions and improvements in its artificial gas plant to cost about $175,000. Plans have been completed. T. Norman Jones is general manager.

West Virginia

NITRO—The Charleston Paper Mfg. Co., Charleston, W. Va., has acquired local property consisting of a number of buildings, on a tract of about 10 acres of land, for the establishment of a new plant. The structures will be remodeled and machinery installed at an early date, with cost estimated at approximately $350,000. Charles G. Hartje, Steubenville, O., is president of the company.

WARWOOD—The Wheeling Oxygen Co., Wheeling, has preliminary plans under consideration for the erection of a new local plant for the manufacture of commercial oxygen products.

MORGANTOWN—The University of West Virginia, Lee Coulter, dean, is completing plans and will soon take bids for the erection of a new 2-story chemical laboratory, estimated to cost close to $400,000, including equipment. Paul A. Davis, 3d, 1713 Sansom St., Philadelphia, Pa., is architect.

PADEN CITY—The Paden City Glass Mfg. Co. will soon break ground for the erection of a new plant addition, 80x140 ft. Bids for equipment will be called during June. The company has recently increased its capital to $150,000 for expansion. David Fisher is president.

Canada

HAMILTON, ONT.—The Firestone Tire & Rubber Co., Akron, O., will soon commence the construction of a new local plant, to be equipped for an initial capacity of 3,500 tires a day. It is proposed to have the factory ready for operation late in the fall.

Industrial Developments

RUBBER—The Armorcord Rubber Co., Morgantown, W. Va., has resumed operations at its local plant following a shutdown for a number of months.

The B. F. Goodrich Co., Akron, O., is arranging for an immediate increase in working schedule from 5 to 5½ days, with 8-hour working day as a minimum in all parts of the mills, and an overtime schedule operative in a number of departments. Production is now on a basis of approximately 18,000 tires a day.

The Hood Rubber Co., Watertown, Mass., has adopted a capacity schedule of production in all departments at its plant with the exception of the rubber footwear branch, which is now running at about 70 per cent of normal.

The Seiberling Rubber Co. is operating on a basis of 2,500 tires per day at its Barberton, O., and New Castle, Pa., plants, the former averaging 1,400 daily of the aggregate, and the latter 1,100 tires.

The Essex Rubber Co., Trenton, N. J., has adopted a double-shift basis of operation in a number of departments at its plant, giving employment to approximately 400 persons. The shock absorber department is running under exceptionally heavy production.

Tire plants at Akron, O., are now running at close to 90,000 tires a day, collectively, or about 90 per cent of maximum production. There is a shortage of skilled labor in the local industry, and a number of plants are advertising for help.

CEMENT—All cement mills in the Birmingham, Ala., district are operating on full time, with regular working force. The plants at Ragland, Leeds and Demopolis are increasing production to maximum and taking on additional employees.

Cement mills in the Lehigh Valley section of Pennsylvania are developing full production, including the Atlas Portland Cement Co., Lehigh Portland Cement Co., Alpha Portland Cement Co. and Coplay Cement Co.

IRON AND STEEL—The La Belle Iron Works has advanced operations to close to 85 per cent of normal at its Wheeling, W. Va., works. The company has inaugurated an improvement program at its Steubenville, O., plant, including blooming mill and open-hearth departments, and will add about 250 additional men to the working force as soon as completed.

The Replogle Steel Co. has blown in its furnaces at Wharton, N. J., following a shutdown for a number of months. During this period the furnaces have been rebuilt and a number of other plant improvements made. A good working quota is being employed and will be increased at an early date.

The Carnegie Steel Co. is now operating at its Homestead, Pa., works on a full 100 per cent basis in all departments. The plant at Duquesne, Pa., is also being brought up to this working basis, and will soon give employment to additional operatives.

A number of plants in the Shenango Valley section of Pennsylvania, vicinity of Sharon, are making ready for considerable increase in outputs. The Sharpsville Furnace Co. is rebuilding its stack and expects to have the unit ready for service at an early date. The Clair Furnace Co. is making improvements in its furnace stoves. The Shenango Furnace Co. is increasing the capacity of one of its stacks to 500 tons of pig iron a day. The expansion and improvement program at the different mills is estimated to cost close to $400,000.

The Wheeling Steel & Iron Co., Wheeling, W. Va., has brought its Top Mill blast furnaces up to 100 per cent capacity, following a curtailment of many months. The Yorkville plant of the company is running on a basis of close to 70 per cent of normal; the Belmont mill is operating at about 65 per cent of regular output; the Benwood plant at slightly better than 40 per cent, while the Martin's Ferry, O., mills are still on the inactive list.

The Gulf States Steel Co., Gadsden, Ala., is increasing production at its local plant; a night force is being assembled for the bar mill, and will be placed in service at an early date, making a double shift for this division of the works.

The American Sheet & Tin Plate Co., Sharon, Pa., has resumed operations at the last of its hot mills at the Sharon, Pa., plant, and is now running full. The company has also placed two more hot mills in service at its New Castle, Pa., works, bringing production up to 100 per cent with complete battery of twenty mills.

MISCELLANEOUS—The Hillside Mines Co. has started operations at its new fluorspar mill near Rosiclare, Ill., and will develop capacity production. The plant has been in course of construction for some time past and has a rated output of 25 tons of crude ore per hour, under single shift. It is electrically operated in all departments, and is one of the largest plants of its kind ever built. G. H. Jones, formerly vice-president of the Inland Steel Co., is head of the company.

The Holly Sugar Co. is planning for the early resumption of operations at its mill at Delta, Col. The plant was closed throughout 1921.

The Hercules Powder Co., Kenvil, N. J., is increasing production at its local plant and adding to the working force. The mill has been running under low production for a number of months past.

The American Smelting & Refining Co., Raritan Copper Co., Barber Asphalt Paving Co. and the Henry Maurer Co., manufacturers of firebrick, etc., all with plants at Perth Amboy, N. J., have resumed operations following a curtailment due to a strike of employees. Approximately 2,500 men have been out with a demand for increased wages. A settlement has been effected on a basis of 5 cents an hour advance in wage scale.

The Ralph Gypsum Co., Le Roy, N. Y., is arranging for immediate operations at its properties in the northwestern section of the city.

The United States Industrial Alcohol Co. is running at full at its plant at Curtis Bay, Baltimore, Md., and plans to double the present output during the coming months, following the completion of extensions and installation of new machinery, now under way. The company has reopened its different branch plants, including the works at New Orleans, La., closed during the early months of the year.

Capital Increases, etc.

THE GRAND RAPIDS PLASTER CO., Grand Rapids, Mich., has filed notice of increase in capital from $250,000 to $400,000.

THE HORWEEN LEATHER CO., 2015 Elston St., Chicago, Ill., has filed notice of decrease in capital from $1,200,000 to $500,000.

E. I. DU PONT DE NEMOURS & CO., Wilmington, Del., has disposed of a common stock issue of $2,000,000, the proceeds to be used for general operations.

THE DETROIT VARNISH CO., 1960 East Milwaukee St., Detroit, Mich., has filed notice of dissolution under state laws.

THE BURNSIDE TISSUE MILLS, INC., East Hartford, Conn., has filed notice of increase in capital from $150,000 to $400,000, for general expansion in paper plants.

THE FORMICA INSULATION CO., Cincinnati, O., has filed notice of increase in capital from $100,000 to $150,000.

THE AMERICAN RADIUM CO., 7 East 42nd St., New York, N. Y., has filed notice of increase in capital from $100,000 to $200,000.

THE ILLINOIS RUBBER CO., Chicago, Ill., a Delaware corporation, has filed notice of change of name to the Nuelle Rubber Co.

THE BOHEMIAN GLASS CO., INC., 17 West 42nd St., New York, N. Y., has filed notice of increase in capital from $25,000 to $250,000.

THE PHILLIPS PETROLEUM CO., 115 Broadway, New York, N. Y., is disposing of a bond issue of $600,000, the proceeds to be used for expansion, general operations, etc.

Property of the VALLEY FORGE MAGNESIA CO., Port Kennedy, Pa., will be sold by the receivers, George Flint and Wilfred S. Griffiths, including land, buildings and equipment.

THE SHELL-UNION OIL CORP., San Francisco, Cal., has arranged for a new preferred stock issue of $20,000,000, the proceeds to be used for general operations, expansion, etc.

New Companies

THE PAPER & PULP PRODUCTS CO., New Haven, Conn., has been incorporated with a capital of $100,000, to manufacture pulp and paper products, and chemicals for treatment of same. The incorporators are Grant Hammond, E. M. Sime and A. W. Chambers, 315 Exchange Bldg., New Haven.

HENRY SUNDHEIMER, INC., New York, N. Y., has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are Henry Sundheimer, N. H. Maas and I. Skutch. The company is represented by Feiner & Maass, 66 Pine St., New York.

THE PACIFIC AMMONIA CHEMICAL CO., Seattle, Wash., has been incorporated with a capital of $300,000, to manufacture chemicals and chemical byproducts. Robert W. Greer is the principal incorporator. The company is represented by Raymond G. Wright, Leary Bldg., Seattle.

THE INDUSTRIAL CHEMICAL PRODUCTS CO., 31 East Woodbridge St., Detroit, Mich., has been incorporated under state laws to manufacture chemicals and chemical byproducts. The incorporators are Wilbert Kromis, Ray J. Smith and Clete Boyle, 1298 Benifeau Ave., Detroit.

THE EUGENE ARNSTEIN PAINT CO., 253 North Western Ave., Chicago, Ill., has been incorporated with a capital of 100 shares of stock, no par value, to manufacture paints, oils, varnishes, etc. The incorporators are Richard Alheim, Carl R. Hines and Alfred J. Parker.

THE RADIUM SULPHATE MFG. CO., Wilmington, Del., has been incorporated with a capital of $100,000 under state laws, to manufacture chemical and affiliated products. The company is represented by Horace G. Eastburn, Ford Bldg., Wilmington.

THE ART BRONZE & IRON WORKS, INC., Danville, Pa., has been incorporated with a capital of $50,000, to manufacture brass, bronze, iron and other metal products. D. J. Reese, Danville, is treasurer.

THE AMERICAN NATIONAL PETROLEUM CO., Paintsville, Ky., has been incorporated with a capital of $60,000, to manufacture petroleum products. The incorporators are M. F. Patrick, Hervie Stambaugh and D. G. Sublte, all of Paintsvilles.

THE INSULATALL PRODUCTS CORP., Buffalo, N. Y., has been incorporated with a capital of $100,000, to manufacture brick, tile and kindred products. A. C. Smith, 2342 Fillmore Ave., Buffalo, is the principal incorporator.

THE SILICON PRODUCTS CORP., Wilmington, Del., has been incorporated under state laws with a capital of $1,250,000, to manufacture commercial silicon and kindred specialties. The company is represented by the Delaware Registration Trust Co., 900 Market St., Wilmington.

THE RITZ CHEMICAL CO., 25 Division Place, Newark, N. J., has filed notice of organization to manufacture and deal in chemicals and chemical byproducts. Walter L. Swartz heads the company.

THE VI-CAR OIL & REFINING CO., Franklin, Ky., has been incorporated with a capital of $100,000, to manufacture refined petroleum products. The incorporators are D. T. Blakey and John S. Milliken, both of Franklin.

THE DALLES FOUNDRY CO., The Dalles, Ore., has been incorporated with a nominal capital of $8,000, to manufacture iron, steel and other metal castings. The incorporators are Carl and C. O. Mattes, and H. U. Martin, all of The Dalles.

THE ELLWOOD CHEMICAL CO., New York, N. Y., has been incorporated with a capital of $5,000, to manufacture chemicals and chemical byproducts. The incorporators are F. Michelson, G. F. Borowski and C. E. Smith. The company is represented by Walter & Woolf, 120 Broadway, New York.

THE GULF TURPENTINE & ROSIN CO., Wilmington, Del., has been incorporated under state laws with capital of $600,000, to manufacture turpentine, rosin and affiliated products. The company is represented by the Corporation Trust Co. of America, du Pont Bldg., Wilmington.

THE VENTURA-COLORADO OIL CO., Portland, Me., has been incorporated under state laws with capital of $300,000, to manufacture petroleum products. P. E. Coyle is president, and A. B. Ewing, treasurer, both of Portland. H. P. Sweetser, Portland, represents the company.

THE TRIANGLE SWEEPING COMPOUND CO., 1105 Garfield Ave., Chicago, Ill., has been chartered under state laws to manufacture chemicals, sweeping compounds, etc. The incorporators are Edwin W. Piper, Armin H. Freitagg and Edgar J. Scott.

THE LUNAPOL POLISH CO., INC., 363 Cal-

vert Bldg., Baltimore, Md., has been incorporated with a capital of $20,000, to manufacture chemicals, chemical compounds, polishes, etc. The incorporators are W. Arthur Darby, F. Stanley Porter and Theodore C. Waters.

THE HOUSTON CLAY PRODUCTS CO., Houston, Tex., has been incorporated with a capital of $10,000, to manufacture brick, tile and other burned clay products. The incorporators are W. M. Merritt, C. L. Hunter and George Kruger, all of Houston.

THE JAMES T. BLUE CHEMICAL CO., Washington, D. C., has been incorporated under Delaware laws with a capital of $25,000, to manufacture chemicals and chemical by-products. The incorporators are James T. Blue, Emery W. Williams and Joseph N. Gowndor, all of Washington. The company is represented by the Delaware Registration Trust Co., 900 Market St., Wilmington.

Industrial Notes

THE DODGE SALES & ENGINEERING CO., Mishawaka, Ind., announces the removal of its New York City branch from 21 Murray St. to the new Dodge Bldg., located at the corner of Park Place, West Broadway and Murray St., and known as 53 Park Place.

THE AMERICAN INDUSTRIAL ENGINEERING CO., Chicago, has recently taken an order from the Tennessee Coal, Iron & R.R. Co. for the installation of complete low-pressure pulverized coal-burning plant for utilizing pulverized coal as fuel under one of the boilers in that company's new power plant at Ensley, Ala. The boiler under which this installation is to be placed is a Sterling 834 hp. designed to operate at 200 per cent of rating. A particularly interesting feature of this installation is in the system of control whereby the operation with this fuel will be practically automatic. The pulverized coal-burning equipment is designed with sufficient capacity to run the boiler on this fuel alone, but it will be operated in conjunction with blast-furnace gas, so that the two fuels can be used independently.

THE NITRO PRODUCTS CORP. and the SEYDEL MANUFACTURING CO. announce the merger of their interests and their future operation under the name of the Seydel Chemical Co., with manufacturing facilities in Nitro, W. Va., and Jersey City, N. J.

THE CELITE PRODUCTS CO., Chicago, Ill., announces that the first large freighter to be loaded entirely with Celite products recently left Port San Luis, Cal., bound for Atlantic ports by way of the Panama Canal. A second freighter is now receiving its cargo, and this will be followed by still another boat also devoted exclusively to their materials. Although the Celite Products Co. has made water shipments quite frequently in the past to the Atlantic coast, this is the first time that three entire vessels have been used to the exclusion of other cargoes. Loaded to capacity, these ships mark a departure from their established transportation method which will undoubtedly be repeated at frequent intervals.

THE METAL & THERMIT CORP., New York, announces the removal of its Pittsburgh branch office from 1427 Western Ave. to 801-807 Hillsboro St.

THE NATIONAL ANILINE & CHEMICAL CO. has moved its executive office to 40 Rector St., New York.

G. M. SHERMAN, formerly representing the Quigley Furnace Specialties Co., has connected with the Keystone Refractories Co. of New York and has been made New England sales manager, with offices at 818 Hospital Trust Bldg., Providence, R. I.

THE AMERICAN-LA FRANCE FIRE ENGINE CO., INC., and S. F. Hayward & Co., their subsidiary, have moved their New York offices to the Fisk Bldg., 57th St., between Broadway and Seventh Ave.

THE HILLSIDE FLUORSPAR MINES announce the completion of a new mine, comprising a shaft three-level development with the lowest level at 350 ft. The plant is electrically equipped throughout, including a mill concentrating building for separation of fluorspar from the impurities in the material as mined. The spar is stored in concrete bins drained and covered to insure dryness and thence loaded direct into railroad cars by belt conveyors. The mine on the original Rosiclare (Illinois) vein is now producing gravel and lump fluorspar.

THE RAYMOND BROS. IMPACT PULVERIZER CO., Chicago, Ill., has established a permanent Western office at 1002 Washington Bldg., Los Angeles, Cal. The office will be in charge of W. B. Senseman.

THE OLIVER CHEMICAL CO. has purchased a site at Penticton, B. C., and will commence at once to erect a factory for the manufacture of spraying compounds. The company, which really consists of John Oliver, Premier of British Columbia, and his two sons, has been operating an experimental plant at Vernon, B. C., for some time, and the company's sprays have met with so much favor in the Okanagan Valley, which is the principal fruit district in the province, that the larger venture has been decided upon.

THE QUIGLEY FURNACE SPECIALTIES CO., New York, announces that the American Supply Co., 135 Washington St., Providence, R. I., has been appointed agent for the Providence district to represent the Quigley company. The Quigley products are warehoused in Providence for quick delivery to local points.

THE RAYMOND BROTHERS ENGINEERING CO., Chicago, has recently been incorporated for the manufacture of equipment for "Rayco" pulverized coal systems for the utilization of pulverized coal as fuel in metallurgical operations, cement plants, and under boilers in power plants, and for the designing and installation of such systems. The new company takes over the business of the American Industrial Engineering Co. of Chicago, which has made a number of such installations, and L. H. Bergman, who has been secretary and chief engineer of the American Industrial Engineering Co., will remain as general manager of the new company. Mr. Bergman has been specializing for a number of years in the design, installation and operation of pulverized coal systems and is widely recognized as an authority on the subject, particularly in connection with the relation of furnace design to the most efficient use of this form of fuel. The Raymond Brothers Engineering Co. is a subsidiary corporation of the Raymond Brothers Impact Pulverizer Co., Chicago. The general offices of the Raymond Brothers Engineering Co. will be at 1315 North Branch St., Chicago.

THE COMBUSTION CO., 4256 North Western Ave., Chicago, Ill., has purchased from the receiver for the General Combustion Co., Chicago, the name, patent rights, drawings, patterns, trade marks and good will, including all contract records.

THE BRISTOL CO., Waterbury, Conn., on May 1 opened a new branch office at Philadelphia, Room 1311, Widener Bldg. C. C. Eagle, Jr., salesman and service engineer, is in charge.

THE ROTHACKER FILM MFG. CO., 1339 Diversey Parkway, Chicago, Ill., has made an eight-reel educational film for the Carborundum Co. entitled "The Jewels of Industry."

Two Italian chemists who have become acquainted to some extent with American methods and American materials through their war experience indicate their desire to make arrangements for representation of American firms in Italy. These men are interested in import of chemicals, chemical apparatus and related supplies. Those who desire to develop Italian markets may care to communicate with Anthony Costa, via le Observanza 22, Bologna, Italy, and Antonio Redaelli, via Lozzaro Palazzi 21, Milan, Italy.

H. H. Buckman and G. A. Pritchard of New York and Mineral City, Fla., announce that they have sold their interest in and severed their connection with BUCKMAN & PRITCHARD, INC., to the Titanium Pigment Co., Niagara Falls, N. Y., which will continue the business in the production of zirconium silicate and other specialties for enameling and affiliated service.

The pulverized fuel department of the Quigley Furnace Specialties Co. has lately been operated as the Quigley fuel systems department of the Hardinge Co., Inc. This pulverized fuel business has now been incorporated as the QUIGLEY FUEL SYSTEMS, INC., with general offices at 26 Cortlandt St., New York City. William H. Baker is president, W. O. Renkin managing engineer and L. W. Marso represents the company in the Pittsburgh district. The new company is entirely independent of the Hardinge Co., although Mr. Baker continues as vice-president and consulting engineer for the Hardinge Co. The company is just completing the largest installation of powdered coal in the world at the steel works of the Societe Anonyme Ougree-Marihaye at Liége, Belgium.

THE CENTRAL STEEL CO., Massillon, O., has appointed Frank Gibbons district sales manager of the Cleveland district, with headquarters at 904 Swetland Bldg.

THE GENERAL ELECTRIC CO. announces that following a meeting of the board of directors, held in New York May 16, C. A. Coffin retired as chairman and was succeeded by Owen D. Young, long associated with the company as vice-president. The position of president was filled by the election of Gerard Swope, president of the International General Electric Co., succeeding E. W. Rice, Jr., who requested to be permitted to devote his entire energies to the further upbuilding of the scientific, engineering and technical phases of the company's work in the broadest sense and who will become honorary chairman of the board of directors. Anson W. Burchard, for many years identified with the company as vice-president, with particular reference to public utilities and foreign investment, was elected vice-chairman of the board. J. R. Lovejoy, vice-president in charge of sales, was elected a director, as was also G. F. Morrison, vice-president.

Manufacturers' Catalogs

HENRY VOGT MACHINE CO., Louisville, Ky., is distributing, upon request, copies of its new bulletin on its new water-tube boiler, which is illustrated and described. The purpose of the bulletin is to outline the factors that should be given consideration when purchasing water tube boilers and to explain briefly the principles of design, the details of construction, and other features of the boiler.

THE CONNERSVILLE BLOWER CO., Connersville, Ind., has issued an attractive catalog, No. 20, on Connersville Cycloidal Pumps. This catalog is limited to illustrations and descriptions of cycloidal rotary pumps, which the company builds in a number of styles for a great variety of applications and in many sizes with displacements as small as 1/20 gal. per revolution and as large as 1,200 gal. per revolution. The construction of the pumps is given and also their advantages.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold a joint meeting with the Pacific Division of the Association, on the occasion of the annual meeting of the latter, in Salt Lake City, June 22 to 24.

AMERICAN CHEMICAL SOCIETY will hold its fall meeting in Pittsburgh, Pa., Sept. 5 to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Montreal, Sept. 21, 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN FOUNDRYMEN'S ASSOCIATION is holding a convention and exhibit at Rochester, N. Y., this week. Meetings will be held in the spring instead of in the fall as heretofore.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting at Niagara Falls, Canada, June 19 to 22. Headquarters will be at the Clifton Hotel.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its nineteenth annual meet- at Bigwin Inn, Bigwin Island, in the Lake of Bays district, Ontario, Canada, on June 21, 22 and 23.

AMERICAN SOCIETY FOR STEEL TREATING will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-fifth annual meeting June 26 to July 1, at Atlantic City, N. J. Headquarters will be at the Chalfonte-Haddon Hall Hotel.

ANNUAL SAFETY CONGRESS OF THE NATIONAL SAFETY COUNCIL will be held in Detroit, Mich., Aug. 28-Sept. 2.

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY will hold a meeting at Lyons, France, June 27 to 30.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH) will be held in New York Sept. 11-16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NATIONAL FERTILIZER ASSOCIATION will hold its twenty-ninth annual convention at the Greenbrier, White Sulphur Springs, W. Va., the week of June 12.

NATIONAL LIME ASSOCIATION will hold its annual convention June 14-16 at the Hotel Statler, Cleveland, O.

NEW JERSEY CHEMICAL SOCIETY will meet at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

The following meeting is scheduled to be held in Rumford Hall, the Chemists' Club, New York: June 9—American Chemical Society, regular meeting.